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PROBLEMS IN INDUSTRIAL ACCOUNTING

BY

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PREFACE

THIS book aims to accomplish two things. First, it endeavors to present a picture of the scope and variety of the problems which confront the executive who desires to be well informed about the costs of his manufacturing operations, or the cost accountant whose duty it is to supply that information. Secondly, it contains an amount of illustrative material sufficient, it is hoped, to show the standard practices of cost accounting methods and technique. All the problems are contained in the second part of the book; the principles and mechanics of cost accounting appear in the first part, and also in the descriptive material which is given in the statement of many of the problems.

The great majority of these problems have been collected by the Harvard Bureau of Business Research, from the business concerns in which they actually appeared. A few of them, the reader will note, have been taken from published records, but these also represent actual cases. As far as possible, all the problems have been given their natural setting, and the actual facts have been stated. Departure from this rule has been made in a few cases only, and for two reasons only; namely, to conceal the identity of the firm in question; or else to bring out in stronger relief the points which the problem is intended to illustrate.

Cost accounting is generally considered to be the most difficult phase of accounting to teach; about no other division of the subject is there so much discussion among instructors as to the mode of its presentation. The principal differences of opinion originate in different views as to what the end and aim should be. Some contend that the student, when he is through the course, should be a finished adept in the handling of all the forms and detailed technique of the subject; that he should be ready to step into a cost accounting office and know how to perform the clerical routine. Others believe that these things should be left alone in a school course, and the student's attention directed to general principles, to the basic purposes of the records and their uses in the management of business.

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The contents of this book are based upon the author's view that the latter of the above purposes is much the more important, but that illustrative material should show the best available examples of the actual methods in use. If a young man is in search of the details of cost methods only, he can acquire them much more readily in the offices of a manufacturing concern; moreover, these mechanics are not in themselves substantial enough material to be worthy of a place in a university curriculum. They become proper educational material only when they are presented as the natural devices for working out many of the problems of manufacturing executives.

In practice, very lengthy and detailed investigations would be made by an accountant called upon to answer questions like those which are raised in these problems. This is true, in particular, of the group of problems relating to cost systems. The question will be asked, whether a student can learn cost accounting by the consideration of problems which attempt, in a few pages, to give the facts of a business which a practicing accountant would study for several months before making recommendations for a system. The answer is, that the student is not trying to do all that the accountant must do. The latter must work out, in complete and exact detail, all the mechanics for the system of records he proposes, in addition to determining the main questions of accounting policy. If the student attempted such a task, his entire year's course might easily be devoted to one system for one business, which would be an obvious waste of time. It is believed, however, that these system problems will afford a basis for a discussion of such features as the appropriate general cost plan, whether job order costs, process costs, or some combination of the two; a list of general and cost ledger accounts; a method of burden distribution, and an outline of the methods of accumulating the costs. In addition, they present to the student the different types of control problems that arise in a considerable variety of concerns. The attempt is made to state each problem at sufficient length to allow of intelligent discussion of the issue raised; though it will always be recognized that the actual decisions in any one case might be varied in accordance with a number of feasible assumptions.

It is hoped that this presentation of the subject, consisting primarily of a collection of the problems which cost accountants

deal with, and secondarily of the methods which the best modern practice employs, will be of value to all those who are interested in the control of manufacturing operations, whether they labor within academic or factory walls. A study of these problems might also help the younger members of the accounting profession to acquire a more definite perception of how the executive regards the cost records and what he expects to get from them—a viewpoint which the leading members of the accounting profession are coming more and more to emphasize. The writer has used many of the problems in the classroom and has found that intelligent and animated discussion can be aroused upon them.

The author will be grateful for all suggestions for improvement, either in the presentation of individual problems, or in the general arrangement of the book.

Many people have helped in the compilation of this book, and to all of them the writer makes grateful acknowledgments. Many of the problems have been obtained only upon condition of strict incognito: the writer therefore refrains from the mention of any names. But to all the manufacturing concerns which have supplied the materials; to those members of the accounting profession who have aided with their advice and suggestions; to the Dean and members of the Faculty of the Harvard Graduate School of Business Administration who have given assistance and encouragement, to the Director and staff of the Harvard Bureau of Business Research who have collected the materials and helped with their organization, and to the assistants of the Accounting Department, sincere thanks and appreciation are hereby extended.

Cambridge, March 22, 1923 T. H. Sanders

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PROBLEMS IN INDUSTRIAL ACCOUNTING

PART I

INDUSTRIAL ACCOUNTING—PRINCIPLES AND PRACTICE

PREFACE TO PART I

PART I contains a brief but comprehensive introduction to the principles and practice of cost accounting. Since more detailed descriptive material is contained in the statement of the problems in Part II, the treatment of the subject in Part I is intended to show only the essentials of what the cost accountant has to do. It is believed that some brief introduction of this sort is necessary before students can attack the problems with confidence and understanding. Part I is not intended, however, to be a resort to the text-book method of presentation; on the contrary, it is believed that a short period at the beginning of the course will be ample time in which to cover this introduction, after which the entire course may be devoted to study of the problems.

One other thought is behind Part I. It is hoped that this statement of what essentially must be done by the cost accountant will aid in accomplishing one purpose of this book, that of subordinating accounting method and technique to the ultimate object, which is to get the information necessary for the control of manufacturing operations.

I

THE WORK OF THE INDUSTRIAL ACCOUNTANT

MODERN manufacturing methods have necessitated the development of accounting records to correspond with the complexities of the problems which are encountered. As soon as a factory becomes larger than can be controlled effectively by the personal supervision of the manager, it becomes necessary for him to exercise his control by means of accounting and statistical information. It is the business of the industrial accountant to provide this information, and in order to do it well, he should have a complete understanding of the problems with which the manager is mostly concerned. The accounting records should, then, be designed to throw light upon those matters in a clear and convincing manner and to provide data upon which the executive can safely base his future policies.

The questions which are uppermost in the minds of the executive will vary, not only between industries, but between different firms engaged in the same line of business. In some industries the material costs preponderate, in others the labor costs are greater, and in others the general manufacturing expenses will exceed either material or labor costs. Facts of this kind will largely determine the amount of attention which is to be given to these several elements of manufacturing expense. Firms engaged in the same industry will vary among themselves in the layout of the plant, in manufacturing methods, in personnel organization, and in the methods which the executives rely upon for getting efficient service from the factory. These things must be studied closely by the accountant, who must make his plans accordingly to show the important factors in the situation in shape to be used by those who are responsible for the management.

PURPOSES OF COST ACCOUNTING

The first duty of the cost accountant obviously must be to find the cost of the product. If there are several or many products, it

is still more important that he should be able to show the separate costs of each of them. But he is also required, under modern conditions, to bring out clearly how well the plant is doing, in comparison with certain standards which have been previously set up. The cost accounting reports should supply information which will indicate all causes of waste and inefficiency. For this purpose the accounts are likely to be subdivided in order to show the costs of different operations and of different departments. If the business owns a power plant, for example, it should be possible to know the costs of developing power and distributing it to the machines, in order to ascertain whether this is cheaper than buying electrical current from the local power station. The departmental costs will enable standards to be set up for each department, and the subsequent records will show how nearly the several departments have come to these standards.

The advantages of knowing the specific costs of each product, and the amount of waste or inefficiency in each manufacturing department are, however, less important to the executive than the advantage of being constantly and reliably informed upon the matters which are his greatest concern. Without this information he cannot be sure that things are what they appear to be; there is always a possibility that unsatisfactory conditions exist of which he knows nothing, and which, therefore, he is unlikely to remedy. A steady stream of reports, bringing accurate information to him every month, will gradually direct his thoughts and form his opinions on sound lines, instead of leaving his judgment to be based on uncertain impressions.

EXAMPLE OF ACCOUNTING, WITH AND WITHOUT COSTS

The field of the industrial accountant's work, and the general procedure by which he accomplishes it, can be more clearly defined by a brief example. Suppose we have the following information given to us, about a manufacturing establishment:

Raw material, beginning inventory	$ 30,000
Goods in process, beginning inventory	40,000
Finished goods, beginning inventory	25,000
Raw materials purchased during period	80,000
Wages of the period	120,000
Manufacturing expenses	90,000
Selling and administration expenses	50,000
Sales of finished goods	410,000

What is the cost of the goods which were sold, and what is the profit upon the business for the period?

These questions can be answered in two ways.[1]

The more common practice is to find out how much of each class of goods is left on hand at the end of the period, which is usually done by taking a physical inventory of raw materials, work in process, and finished goods. Having this information, it is assumed that the goods which were on hand, but are not there now, have been sold. The cost of goods sold may then be computed. For example, the following figures might be given for the inventories at the end of the period in the case above mentioned:

Raw material, final inventory	$25,000
Goods in process, final inventory	30,000
Finished goods, final inventory	30,000

With this information it will be possible to construct an operating statement in the usual form which will appear as on page 6.

It is to be noted that this information is available to us without any cost accounting, simply by keeping records of the financial transactions of the business, its purchases, and labor costs, and expenses, and its sales. The taking of a physical inventory is all that is necessary to complete the statement. It will, however, be clear that by these methods we cannot be sure that the cost of goods sold is correctly stated. At any rate, we cannot say that we have complete information of the elements in cost. Materials may have been wasted; labor for which wages have been paid may be inefficient; expenses may have been incurred unnecessarily. In any of these cases the expenditures will have produced neither goods for sale, nor goods which are included in the inventory. Information about such things is concealed in the total figures shown, and could not be discovered by the methods described.

What, then, is the more direct method to follow? If we can obtain information about the movement of goods and the progress of manufacturing operations inside the works, we can find out by direct methods what the cost of the goods manufactured and sold has been. If, for example, we can ascertain the amount of raw materials transferred into the manufacturing departments; the amount of labor put on each item of product; and (in some

[1] A more complete discussion of these two methods of accounting may be found in the *Fundamentals of Accounting*, by W. M. Cole, Chapters 6 and 7. See also *Journal of Accountancy*, March, 1921, pp. 176-186.

OPERATING STATEMENT

SALES OF THE YEAR			$410,000
Less Cost of Goods Sold, viz.:			
Goods in Process, Beginning Inventory		$ 40,000	
Materials, Beginning Inventory	$ 30,000		
Materials Purchased	80,000		
Total Materials Handled	$110,000		
Less Material Inventory, End	25,000		
Cost of Materials Used		85,000	
Wages of Period		120,000	
Manufacturing Expenses		90,000	
Total Production Costs		$335,000	
Less Goods in Process Inventory, End		30,000	
Cost of Goods Finished During Period		$305,000	
Add Beginning Inventory, Finished Goods		25,000	
Total Finished Goods Handled		$330,000	
Less Final Inventory, Finished Goods		30,000	
Cost of Goods Sold			300,000
Gross Profit on Sales			$110,000
Less Selling and Administrative Expense			50,000
Net Profit on Sales			$ 60,000

way) the amount of general expense properly belonging to each item of product; and if we can continue the process of attaching expenditures to the products as the work progresses through the factory, we shall know how much it has cost to make the completed goods. If we also keep a record of the amount of finished goods transferred from the manufacturing departments to the finished stores, we shall have direct information of the amount of finished goods on hand, and we shall always know what they cost. Whenever any of them are sold, therefore, we shall know the cost of the goods which were sold.

In the case described above, the following would be the additional information which would be required in order to get directly at the cost of the goods which were sold:

Materials transferred into process	$ 85,000
Finished goods transferred to finished stores	305,000
Cost of finished goods sold	300,000

Having accumulated this information, and having it always available, we can ascertain a profit at any moment by comparing the cost of goods which are sold with the selling price.

METHODS SUBORDINATE TO PURPOSES

Here, then, is the fundamental difference between cost accounting, and ordinary financial accounting without cost records. Cost accounting gathers information about the internal movement of goods in the plant, instead of merely making record of goods which move into the plant by purchase, and goods which move out again by sale. The methods by which this information about these internal movements is gathered together constitute the machinery of cost accounting. The complexities of manufacturing processes, and the scientific and technical bases upon which they rest, must necessarily find reflection in the cost accounting methods, and frequently make the procedure very complicated. But it cannot be too strongly emphasized that the only purpose of cost accounting forms and methods is to get the desired information, and to give the desired control. Methods which will do this well in one factory are often inadequate in another, and it is the cost accountant's duty to devise methods which will work most efficiently in the particular case.

II

METHODS OF COST ACCUMULATION

THE manufacturing cost of any article consists of the wages paid for the direct labor entering into it, the cost of the direct material which is contained in it, and a proper share of the general manufacturing expenses—commonly called the burden or overhead. It is necessary to find a means by which these costs may be accumulated in a simple and practicable manner in order to give a reliable total cost.

The first thing to determine is a unit or quantity of product for which the costs shall be assembled. Usually it is neither possible nor desirable to find the cost of single items of product; it is more feasible to find the cost of groups or lots which can be conveniently handled in the manufacturing processes. How much, or how many, of the product shall we use, therefore, as a basis for finding the cost?

The answer to this question depends entirely on the nature of the product and of the manufacturing processes, the organization by which the work is routed through, and the quantities which are put through at a time.

TWO GENERAL COST METHODS

There are two principal methods of cost gathering; first, to find the cost of a specific order or lot, and second, to find the cost of the entire product of a given period, such as one month. In devising a cost system, the question as to which of these two is the more suitable is usually the first one to be answered. It is not always practicable to separate the two methods entirely or to adhere wholly to one method, to the exclusion of the other; in particular it will sometimes happen that one method will be used at one stage of manufacture, or in one department, and the other method at another stage or department.

It will be clear that the job or order method of costing can be used only where the order or job can be traced distinctly through

the works; it must keep its separate existence and identity throughout, and not become merged with other lots. The most obvious use of this method is in industries where the product is made to the order of a specific customer, whose name is attached to it throughout. Examples will make the situation clear. In the commercial printing industry, all work is done to the order of customers; no printing is done unless some customer has previously ordered it. This, then, is a case where goods are manufactured to order, and the order method of cost finding is used. The same thing is true of the building and contracting business, where every construction job is undertaken upon an order from some customer. Most shoe factories, though not all of them, make shoes upon orders which have been taken by traveling salesmen, and do not make them in advance for stock. Other examples could be mentioned, but these will suffice to indicate what is meant.

The other method of cost finding is specially adapted to industries where the materials pass through in bulk, in a continuous stream of processes. For this reason it is commonly spoken of as the process method of costing; the costs of operating the processes. Examples of this method are afforded by the chemical industry, sugar refining, and tanning. In each of these the normal thing is to make no distinction between the goods made for one customer, and goods of the same grade made for another customer. The product flows on through the processes in a continuous stream. At the end of the month, the costs of operating a sulphuric acid plant, for example, may be assembled, with the cost of materials put into process: the total of these is the cost of manufacture of the number of gallons of sulphuric acid produced, and from this a unit cost can easily be computed. In gathering such costs, due allowance must of course be made for inventories on hand at the beginning and end of the period.

The distinction between the order method of cost finding, and the process method, does not exactly coincide with the distinction between manufacturing to customer's order, and manufacturing for stock. In nearly all cases where goods are manufactured directly on a customer's order, the order method is the obvious one to use; but all manufacture for stock does not call for the process method. It may be that, although goods are made for stock, they are made in definite lots upon "production orders," i. e.,

orders calling for specific quantities, and emanating from the department which plans production. If the management is interested in knowing the costs on these specific lots, then the internal production orders assume the same position as customers' orders, and the order method of cost finding will be employed. But if they are not interested in the cost of specific lots, but only in total costs and total production for the period, then the cost finding methods will resemble those for process costs.

To sum up, the order method aims to find the cost of a specific lot or order; it is especially useful in cases where goods are made to order or on contract, for which an estimate has previously been made, and a price quoted to the customer. The process method aims to find the total cost of operation for one period, the total production, and the resultant unit cost. It is used chiefly where the product moves continuously through several processes, with little or no distinction between lots.

It is clear that the total cost of the product will be accumulated in very different ways for the two cases which have been described. The sheet on which the total costs of any product are brought together is called a Cost Sheet. In the case of the job-order method there would be a cost sheet for each order, in which all the direct labor and material used on that order are shown, together with an additional charge for burden or overhead, computed on some basis afterwards to be discussed. With process costs, however, there would be one cost sheet each month showing the total amount of wages, the materials used, and the appropriate addition for overhead, thus covering the operations for one month. The total output for the month will then be found in order to supply a basis for getting a unit cost.

In both cases the cost sheet will be subdivided, and spaces will be provided for all the materials used and all the departments or operations through which the product passes, in order that all the component parts of the cost may be clearly exhibited. A form of cost sheet widely used in the printing industry is shown in Form 1, on the opposite page, upon which will be seen space for the several materials which may enter into a printed product, such as paper, ink, electrotyping, and binding materials, and also for the separate departmental operations through which the work passes, such as

Hand composition
Machine composition
Printing on the job presses or cylinder presses

INDIVIDUAL ORDER SUMMARY

For_____ Order No._____
Description_____ Date Entered_____
_____ Customer's No._____
Previous No._____ Date Billed_____ Amount_____

Bindery_____

Emp. No.	Date	Kind Work	Time	SUMMARY Materials	Itemized Cost	Cost to Post *	Estimated or Itemized Selling Price	Sell to Post *
				Paper				
				Bindery Materials				
				Ink				
				Misc. Purchases				
				Total Materials				
				Cost Handling %				
				Total Materials and Handling				
				LABOR AND OVERHEAD				
				Composing - Hand Work Hrs @				
				Alterations " "				
				Machine Composition " "				
				Machine Composition " "				
				Alterations " "				
				Job Press " "				
				Cylinder Press " "				
				_____ Press " "				
				Cutting Machine " "				
				_____ Machine " "				
				Bindery C, Girls Small Machs. " "				
				Bindery D, Girls Hand Work " "				
				_____ Overtime " "				
				_____ Overtime " "				
				_____ Overtime " "				
				COST COMPLETED WORK				
				SELLING %				
				TOTAL COST				
				BILLED PRICE				

* To be used when interlocked with U.T.A. Standard Accounting System.

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Form 1: Printers' Cost Sheet

Form 2, below, is a cost sheet such as is used in many coal mines. In this case, also, it will be seen that the costs for labor and supplies are shown separately for each of the principal mining operations; but this sheet does not show the cost of mining the coal supplied to one customer; it shows instead the costs of one month's production, which, when divided by the quantity

Sheet 1

For Name of Company

19___

Report of Cost, Income and Tonnage

For Month of_____

COST

Line No.	ACCOUNT	CURRENT MONTH				YEAR TO DATE	
		LABOR	SUPPLIES	TOTAL		TOTAL	
		Amount	Amount	Amount	Per Ton	Amount	Per Ton
1	**Mine**						
1	**Operating Expenses**						
2	Mining						
3	Timbering						
4	Deadwork						
5	Track Laying						
6	Drainage						
7	Ventilation						
8	Haulage and Hoisting						
9	Dumping and Tallying						
10	Preparation						
11	Railroad Car Loading and Yard Expense						
12	Power						
13	Repairs to Buildings and Permanent Structures						
14	Mine Office						
15	Superintendence						
16	Engineering						
17	Sundries						
18							
19	Total						
20	Additions or deductions account of sale of explosives, etc.						
21	Total Mine Operating Expense						
22	**Other Operating Charges**						
23	Royalty						
24	Depletion						
25	Depreciation						
26	Insurance—General						
27	Insurance—Liability or Compensation						
28	Taxes (exclude Income and War Profits)						
29							
30							
31	Total Other Operating Charges						
32	Total Operating (add lines 21 and 31)						

produced from the form recommended by the National Coal Commission

Form 2: Coal Cost Sheet

produced, will give the cost per ton. This form shows only the operating expenses: two other forms show general and selling expense, and the income statement, with number of tons mined.

Frequently it is necessary to make combinations of the two forms of cost sheet here exhibited. Sometimes both forms will be used in the same manufacturing plant, a form showing process costs during the earlier stages of manufacture, and a form showing job-order costs at a later stage, where the articles are finished for customers. This might occur, for example, in a woodworking mill, where lumber is first sawn into standard sections, which are afterwards worked up into finished articles to customer's orders.

In every case the procedure will be adapted to the necessities of the business; the form used will be designed to display clearly the principal elements in the cost of the article, and the major elements of the costs and processes should be evident at a glance. But it will always be necessary at the start to determine whether the situation calls for an accumulation of the costs upon the order basis or upon a process basis.

III

COST ACCOUNTING AND PRODUCTION CONTROL

THERE is not always the most complete harmony between the cost accounting department of a manufacturing plant and the factory officials who are responsible for getting the work done. We are sometimes told, in fact, that more commonly than not, duplicate and parallel sets of records are to be found in a factory, one of them kept by the cost accounting department for its purposes, and the other by the production or planning department for its purposes.[1] Production managers, efficiency experts, and "scientific management" people frequently refer to cost accounting as a somewhat useless procedure which, whatever its merits, offers very little advantage to them. Their principal criticisms are to the effect that cost accounting, in preserving an exact balance between debit and credit, becomes quite wooden in its adherence to purely mechanical methods; further, that cost accounting does not tell them what they want to know; and again, that when the accounts do bring out information which might be of interest, it is so old as to be of no use for any practical purpose.

COST AND FINANCIAL ACCOUNTING

It is also customary to draw distinctions between cost accounting and financial accounting, to the effect that the nature and the methods of the two are essentially different; engineers, factory managers, and others responsible for getting work done, frequently attempt to make such contrasts, but not always with great success. If we take it that financial accounting must record the transactions of the business with the outside world, these transactions will consist, on the one hand, of the outlays which are incurred for productive purposes, such as the buying of materials and the payment of wages and expenses; and on the other hand of sales of the finished product to customers. But

[1] *N. A. C. A. Official Publications*, Vol. II, No. 15, p. 6.

without cost accounting there is no adequate connection between these two classes of transactions; there is no assurance that all the expenditures which were incurred for production have been properly attached to the finished products which were sold. It was shown in Chapter I that the procedure in such cases is to take inventories of the raw materials, work in process, and finished goods which remain on hand, and to assume that all the other expenses which have been incurred applied to the goods which were sold. In the absence of cost accounting, we are reduced to this indirect method of computing cost of sales. But cost accounting occupies the ground between the transactions representing productive expenditures and the transactions representing the sales of the finished product; a direct connection is thereby established between the two. The outlays which have been made for materials, labor, and manufacturing expenses are taken up and attached to the specific product or processes upon which they apply. It may be that this attachment of the cost to the product cannot be done in one step, but requires several. Nevertheless, cost accounting procedure will carry the expenditures through the various stages of manufacture and ultimately will attach them to the product where they belong.

In doing this it is desirable that the cost accounting should be tied in with the regular double entry system of financial accounts. In this way *all* the expenditures undertaken for manufacturing purposes will be accounted for in the cost records and any amounts which for any reason cannot be attached to specific products will show up as unabsorbed balances, the explanation of which will constitute one of the functions of the cost records. In the absence of such a tie-up between the cost and financial accounts, the cost accounts are likely to depart from the financial records and there is no guarantee of their reliability.

The purposes of cost accounting and its relation to other phases of factory management can best be shown by a more detailed consideration. The cost of any product, as stated before, includes the cost of the materials and labor which enter directly into its manufacture, to which must be added an appropriate share of the general manufacturing expense. All accumulation or analysis of cost begins with this grouping, and a brief study may be made of what essentially has to be done with regard to each.

MATERIALS

What does the cost accountant wish to know about materials? He wants to know what materials enter directly into the manufacture of the various products, the quantities of these materials, and their costs. Second, he wants to know what other subsidiary materials are used which cannot, perhaps, be considered as direct materials and must, therefore, be included in the general manufacturing expenses. The quantities and costs of these are also necessary. Third, he requires to know what materials are still on hand, available for future use.

What must the works management know and do about materials?

1. The management must see that adequate supplies of materials are on hand at all times.
2. It must provide proper storage for them and see that they do not get damaged or stolen.
3. It must see that the materials are issued only to the proper people, under the proper circumstances, and for proper purposes.
4. After the materials have been issued from stores, the management must see they are properly and economically used in the manufacturing processes.

Clearly, it is possible to accomplish both the cost accountant's and the works manager's purposes together. These purposes may be carried out by the following procedure:

1. A record must be kept to indicate the quantities of each kind of material on hand, the additions which are made to them by purchases, and the subtractions to be made for materials issued to the manufacturing departments. The cost of the several lots must also be shown. For this purpose a "balance of stores" system is usually employed, consisting of a card index with a card for each item.
2. Issues of the stores to the manufacturing departments will be made upon written requisition showing the quantity and cost of the materials being taken out.
3. These requisitions indicate the job number or product which is to be charged with the materials so issued. In this way the material costs become definitely attached to the product on which they apply.

LABOR

What does the cost accountant wish to know about labor?

1. As with materials, he wishes to know how much labor enters directly into each job or product and the cost of such labor.
2. He must know how much indirect labor is incurred for general purposes, such as inspection, supervision, care of building and machinery. This indirect labor must be provided for in the overhead or general expense accounts.

The factory management in exercising control over labor must know:

1. That the work people are in the works during working hours;
2. That they are properly employed while in the works;
3. That the information for making a payroll is available so that the work people may be properly paid at the proper time;
4. That the labor is efficient, performing operations in approximately standard time.

Here again the purposes of cost accounting and management may be combined, and worked out by the following procedure:

1. Time clocks or other devices would be installed to record the time when the work people enter and leave the premises.
2. Internal time clocks or other devices will be used to show when the individual workers begin and finish work on individual jobs. This set of time records must, of course, agree with the in and out times shown on the other records.
3. Production orders or other instructions to work people must be issued in writing to show them what to do and when to do it. These same records will also record the actual accomplishment of the work, together with the remuneration attaching to it.
4. Production reports will be made showing how much has been produced.
5. From the records already mentioned it is possible to get the information for compiling the payroll and also for finding the labor costs for the goods which are made. The instruction tickets can be summarized first according to men, which gives the payroll, and second according to products, which supplies the labor costs of the product.

OVERHEAD EXPENSE OR BURDEN

What must the cost accountant know about general manufacturing expenses?

1. He must have full information about all the various items of expense, and be assured that all expenditures which have not been included under the headings of material or labor shall be included here.
2. He must be clear as to precisely for what reasons these expenditures have been incurred.
3. He must work out some method for dividing or distributing these general expenses over the various products in order that each one, or each class at least, may bear its proper share.

What interest does the factory management have in general manufacturing expenses?

1. In so far as factory managers are held responsible for these expenses, they must have opportunity to authorize them.
2. Periodical reports of manufacturing expenses must be made to the factory executives, preferably divided into two groups; namely, variable expenses which are mainly under the control of the factory management, and for which they should be held fully responsible; and those fixed changes such as depreciation, taxes, and insurance, for which the factory managers cannot be held responsible, but which are needed to complete the report of manufacturing expense.

It is in gathering together the various items of general expense and in distributing them fairly to the products that the principal difficulties of cost accounting arise.

1. The cost ledger (explained in Chapter VII of Part I) contains expense accounts which show the required information as debit balances. These debits arise when actual cash expenditures are made, or when liabilities are incurred for expense purposes. Sometimes it is not considered advisable to carry all this information in the shape of ledger accounts; instead, accumulation sheets are used which show the amount of each item of expense for the current period, and the total accumulated to date.
2. Whichever method is used, the information is thereby made available, both for giving the total amount of general expenses

which must be included in the cost accounting records, and also to compile the reports for factory managers.

3. These same records of manufacturing expenses for the current and for past periods will provide information from which we may know how best to divide the total of general expenses and allocate them in fair proportions to the several products.

4. This will usually be done by working out a rate, which can be applied in some simple way as an addition to each job or product, which addition will constitute its burden charge. For example, a labor-hour rate may be worked out, which means that for every hour of direct labor put into the job, there shall be added, say 80 cents for overhead; or the rate may be on the basis of labor cost, and may require that a percentage of the direct labor cost shall be added as the indirect charge; or a machine rate might be worked out to show the cost of running each machine per hour, in which case a job will be charged this hourly rate for every hour that it occupies the machine on which it is made.

COOPERATION NEEDED

The general conclusion of this survey is that cost accounting records and the managerial control of the operations may be provided for simultaneously, and there is no occasion to carry on a duplicate set of records. But in each individual case it is necessary for the cost accountants and the works managers to agree upon a procedure which will be satisfactory to them both. It will then be possible to work out plans by which the factory executives may be promptly informed upon matters in which they are interested, and the cost accountants enabled to accumulate the financial results of the manufacturing operations. This kind of cooperation is especially necessary in determining which of the control records need to be expressed in terms of money, and incorporated in the accounting system; and which of them may be adequately served by keeping only quantitative statistics, such as quantity of materials used, amount of time taken on operations, quantity of goods produced, and the like. Where information of this sort satisfies all practical purposes, it is useless for the accountants to carry records further by making detailed money computations for the same purposes. But neither of the parties to this controversy can, as a rule, supply the ideal answer; that must come as a result of their joint deliberations.

IV

MATERIAL COSTS

In this chapter it is intended to describe the procedure which is followed in ordering, purchasing, receiving, inspecting, requisitioning for process, and keeping the costs of, materials.

The term "materials" here includes all those materials which enter directly into the manufacture of the product so that they can be plainly identified with it. Such materials can be treated as a direct cost of the product, and the amount chargeable to the product for them is easily ascertainable. Materials which are used in small quantities only, so that the precise quantity used in any one article would be somewhat difficult to measure, are not regarded as direct material costs, because the computation of the amount would be more trouble than it is worth. In making a desk, for example, the lumber used in it, and the principal metal fittings, would be treated as direct materials, the costs of which would be charged as separate items to the desk; but varnish and polishes would be treated as indirect materials and included with the overhead expense. The dividing line between direct materials and indirect materials which are to be included in the overhead is not always easy to define, but in any particular case a common-sense division is all that is necessary. In printing, for example, if the job is of considerable magnitude requiring a special supply of ink, then a separate charge for ink might be made to the job under the head of direct materials. But if the job is a small one which can be run off with the ink already on the rollers, no special charge would be made for this ink; it would be included in the general overhead.

MATERIAL STORES CONTROL

In well-arranged factories it is the custom to have the materials and supplies kept in storerooms, under the charge of storekeepers who are responsible to see that a supply of each article is always on hand, that they are kept in an orderly manner so

that they can be located when wanted and will not suffer damage, and that they are issued from the stores only to proper persons with properly written requisitions. It is not always possible to have such a system complete, but it is the standard practice which should be kept in mind when matters of this sort are under discussion.

Under a system of scientific control for materials, or "balance of stores" system, as it is frequently called, a minimum quantity for each article is fixed, and when the supply on hand runs near the minimum the storekeeper must issue an order for more. The minimum quantity is ascertained by noting, among other things, the rapidity with which the article is consumed and the time required to obtain a new supply. The quantity which he should order is also specified and this quantity is determined with reference to the same considerations. The "minimum inventory" and the "quantity to order," when this minimum is reached, must operate together so that an adequate supply may be at all times assured. The main considerations are, on the one hand, that we desire to have as little money as possible invested in inventories, and on the other hand, that we do not wish to have manufacturing operations held up because some little part has run out of stock.

PURCHASING MATERIALS

When the storekeeper needs a further supply of an article which is purchased from outside, he addresses a purchase requisition to the purchasing department, stating what material is needed and, if possible, what it is to be used for. If the article is one which is manufactured in the plant, this requisition will be addressed to the department which issues production orders. The purchasing department, upon receipt of the requisition, will issue a purchase order to the outside firm which supplies that article. When the goods arrive, the receiving department makes a material received report, showing from whom the material is received, its name, quantity, and the purchase order number on which it was supplied. Usually the receiving department is not previously advised of the quantity which is expected, in order that an independent count may be assured; the "material received" report will then enable the purchasing department to check the

vendor's invoices. If the materials have to be inspected before they can be put into the stores there will be a form of inspector's report, also to be supplied to the purchasing department to enable it to pass the invoices. If everything is found in order, the materials are put into their proper place in the stores and the purchasing department approves the invoices for payment. On the books this cost is debited to Materials or Stores, and credited to Accounts Payable.

BALANCE OF STORES RECORD

In addition to the ledger accounts for materials, however, there will be the "balance of stores" record. This is made up with one sheet, or one card, for each article or kind of material. The cards will be arranged in some convenient order, and the total amount of materials shown on them as being on hand should agree, when the records have been completed to date, with the amounts shown in the ledger accounts for materials. Specimens of this balance of stores record are shown in problems relating to materials, and also in Form 3, below.

The methods of recording the receipt of materials and their

Size—No.							Unit						Maximum			Minimum		
													Location					
																Rack		Bin
ORDERED and RECEIVED							ISSUED						ISSUED					
Date	Order No.	Invoice No.	Quantity Ordered	Due	Quantity Received	Unit Cost	Date	Req. No.	Dept.	P.O. or App. No.	Quantity	Balance	Date	Req. No.	Dept.	P.O. or App. No.	Quantity	Balance

Form 3: Balance of Stores Record. An inventory of over 4,000 articles is kept on cards like this, with a high degree of accuracy.

issue will be followed easily from the headings; sometimes there is a column for "materials apportioned," which means that notice has been received that certain materials will be required in the near future for a specific order and should be retained for that purpose. These materials are still in the stores but are no longer available for future orders and must, therefore, be deducted before the balance available is arrived at.

The balance of stores record is an office record; it is further supplemented by the "bin tag," a small card attached to the actual materials and containing spaces for the in and out quantities. This record should, of course, tally with the balance of stores record in the office and also with the physical quantity in the bin. It is usual to check the physical quantity periodically when the supply is low; if a few articles are checked every day, the record can be kept in reliable condition. Sometimes a form is used to record this daily check; on it are shown the kind of material, the physical quantity on hand, the quantity shown on the tag, the discrepancies to date, and the name of the checker. This insures that the checking operation shall be steadily maintained and also that discrepancies between the physical count and the stores record shall be adjusted.

ISSUE OF MATERIALS FROM STORES

The means of withdrawing materials from the stores must next be described. For this purpose a form known as a material requisition is commonly used. This form mentions the material needed, the quantity, the department to which it is to be supplied, the order to which it is to be charged, and it is signed by the person who makes the requisition. The form may be drawn in any shape convenient for the business; one example is shown in Form 4. In cases where the product consists of an assembly of many parts, or where the product is a mixture of several materials which have to be compounded together in definite quantities, the form of requisition frequently takes the shape of a "bill of material." This is simply a requisition from the storekeeper for a variety of articles, and if the assembly is a standardized one, it becomes possible to indicate the entire list of materials with one symbol. These requisition forms supply the basis for a computation of the material costs. The total

Stores Ticket Number _____			Charge Order Number _____	
Quantity Issued	Unit		Quantity	
	Unit Price	Total Value	Symbol and Name	
			Machine or Department	
			Written	Month Day Year
			Delivered	
To Storekeeper: Please supply the above to bearer (Signed) _____				
Stores Records	Cost Account	I have issued above stores _____ (Storekeeper)		

Form 4: Material Requisition Slip

quantities of each kind of material will be accumulated at the end of the month, and charged to the orders or processes in which they have been used. Figures are thereby obtained by which an accounting record can be made, consisting of a credit to the material account and debits to the processes or orders. These requisitions must also be noted upon the balance of stores records, and upon the tags attached to the materials themselves; the requisition form often contains a space in which note must be made when these records have been written up, as shown in Form 4.

PRICING MATERIALS AT ISSUE

When the materials are issued from stores upon requisition of the manufacturing departments, a price will have to be put upon them to form the basis of the charge to the product. In case of variations in purchase prices, some question may arise as to the price which shall be used for this purpose. There are four main methods used in practice, though other variations of them are to be found.

(1) The materials may be priced for issue at the purchase price of that particular lot. This practice obviously requires that either the lots shall be kept physically separate in the storeroom, so that when the one lot is finished a new price may be used; or else the records themselves must show when this change shall be made.

(2) An average price may be worked out from the purchase prices of all material in stock at the time; the average would clearly have to be changed when new purchases were made at different prices.

(3) Materials may be charged out at the price of the last purchase. This price may be "up to date," but it may involve a departure from the cost basis.

(4) A standard cost may be adopted, as described in Chapter VIII, Part I.

MATERIAL RECORDS SUMMARIZED

The material records may be summarized as follows:

Materials Received

Monthly

Every month the total value of all materials received will be debited in the proper ledger accounts, and also in the proper subordinate records.

Daily

The balance of stores record, and the tags on the materials, will be written up to show each addition to the supply of materials on hand of each kind and class.

Materials Used

Monthly

The totals of all materials issued from stores into process will be credited in the material accounts and debited to the work in process accounts. A corresponding transfer will be made in the control accounts in the general ledger, if the method of control requires it.

Daily

The requisitions for materials will be recorded on the balance of stores cards and on the tag records. These two records, therefore, show the actual balance on hand at all times, and constitute the perpetual inventory.

BOOK INVENTORY FOR BALANCE SHEET PURPOSES

The question is sometimes raised as to how far a perpetual inventory of this sort can be relied upon for the purpose of ascertaining the total inventory value to be used in the financial statements. Doubt is sometimes expressed of the reliability of

the book inventory for this purpose. Anyone acquainted with the difficulties of getting a reliable physical inventory will, however, not place too much confidence in the figure obtained by that method. "If it is an up-to-date and scientifically kept book inventory it will usually be found more trustworthy than any physical inventory that is likely to be taken." [1] The usual experience is that a cost system with book inventory does not work entirely smoothly when first installed, but needs constant readjustment. By careful attention to the causes of trouble, however, errors can be reduced to a minimum, and after a year or two a condition of reliability like that referred to in the above quotation can be reached. There are cases in which a book inventory has been made to check regularly with actual quantities, within one-half of 1%.

[1] J. Hugh Jackson, *Audit Working Papers*, p. 34.

V

LABOR COSTS

THE cost of direct labor employed upon a product constitutes one of the three main divisions in the cost of its manufacture. If all classes of manufactured product are included, it is probable that the labor costs will be well in excess of one-third of the total costs. When it is added that overhead expenses are frequently computed upon the basis of the labor cost or the labor-hour, it becomes evident that no satisfactory cost records are possible without accurate and reliable labor records.

A series of labor records will consist substantially of the following stages:

1. The workman's time and production must be accurately recorded on work or job tickets
2. These work or job tickets must be summarized to give
   a. The total amount due to each man for work done
   b. The total amount paid for work on each order
   c. A list of the workers, with the amount due to each, constituting the payroll
   d. The charges against individual orders or products for the total amount of work done on each, constituting the labor cost of those orders or products
   e. The ledger record, made by charging the total amount of payroll to Work in Process and crediting it to Payroll Accrued; the latter account being, of course, debited when the wages are paid

These essential operations are somewhat simple, but it is not always easy to devise the simplest and most efficient set of labor records to suit any particular situation. It is necessary to consider the nature of the product, the organization of the factory, the clerical and mechanical facilities for making records, and the character of the employees. A few questions arising out of these circumstances will illustrate the considerations which have to be weighed in this connection.

WHO SHALL KEEP TIME?

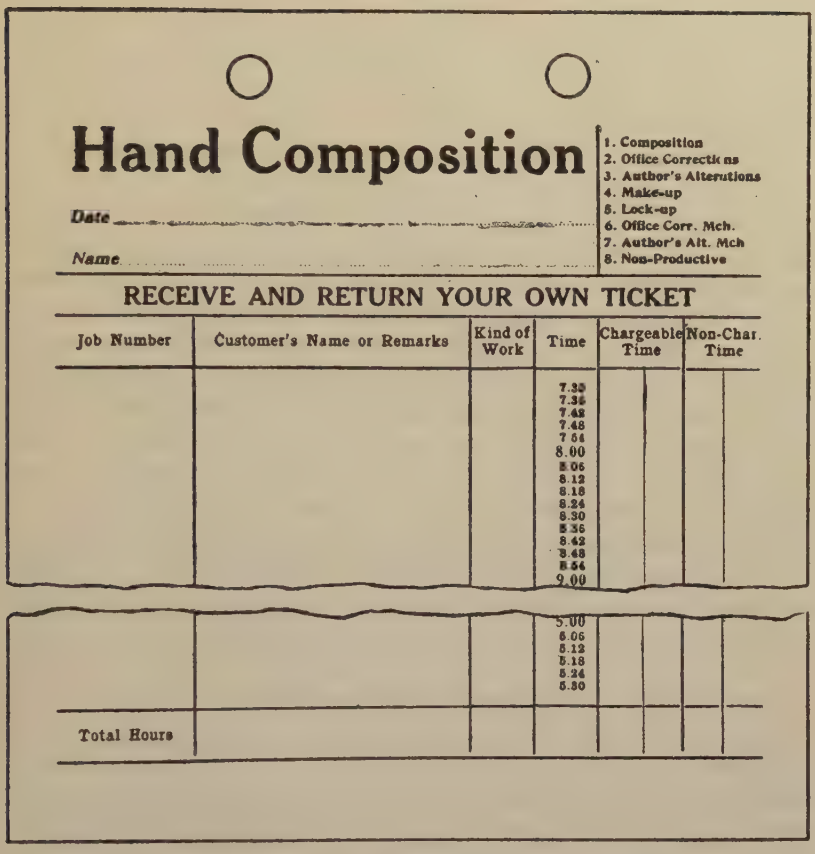
Shall the workers themselves keep the work tickets or shall these records be kept by special time clerks, or in some cases, by the foreman? In general it is desirable for the workers to be called upon for as little clerical work as possible. It interrupts their principal business, it gives an opportunity for them to change the records to their own gain; their indifference or carelessness will result in inaccurate records; attempts to check them up or to make them more careful can easily produce friction; and the physical environment is often not conducive to the making of the most satisfactory records by the workers. For these reasons it is frequently quite unsatisfactory to have the workers keep their own time records. On the other hand, there are other occasions upon which it is done with satisfactory results. The United Typothetae of America, for example, use the time ticket shown in Form 5.

One of these is provided for each workman each day. All that is necessary is for him to draw a line under the time at which he finishes one job and begins a new one, to write in the numbers of the jobs, and to turn it in at the office each day. From this the cost office can compute the amounts chargeable to the several jobs on which he has been working.

If the time is not recorded by the workers, it is clear that it must be kept by special time clerks or by mechanical time clocks. These, of course, involve additional expenditures; and as the time clerks are supposed to pass around among the men for the purpose of getting the times when they change from one job to another, there is opportunity for delay and discrepancy between the actual times and the times recorded. In all the most up-to-date and efficient factories, mechanical time-recording devices are in use and the system of labor records is built up around them.

THE ORIGINAL LABOR RECORD

Shall the primary labor record be a record for each job, or for each man? A record kept by jobs obviously would be the most convenient for the purpose of finding the costs of individual jobs; the latter would be more convenient for accumulat-



Hand Composition

Date .....

Name .....

1. Composition
2. Office Corrections
3. Author's Alterations
4. Make-up
5. Lock-up
6. Office Corr. Mch.
7. Author's Alt. Mch
8. Non-Productive

RECEIVE AND RETURN YOUR OWN TICKET

Job Number	Customer's Name or Remarks	Kind of Work	Time	Chargeable Time		Non-Char. Time	
			7.30 7.36 7.42 7.48 7.54 8.00 8.06 8.12 8.18 8.24 8.30 8.36 8.42 8.48 8.54 9.00				
			5.00 5.06 5.12 5.18 5.24 5.30				
Total Hours							

Form 5: Printers' Time Ticket—Reverse for Overtime

ing the payroll. There are a number of difficulties connected with a man record. For example, it is not available, until the end of the period which it covers, for posting labor costs to the individual jobs which it includes. A job record, on the other hand, is complete as soon as the job is finished, and can be used immediately for the purpose of the accumulation of the subsequent records. A ticket for the job, moreover, lends itself more readily to the making of detailed records for complicated operations, and also for methods of wage payment other than a simple time basis.

Very frequently these primary labor records are incorporated in the body of a production order or a route sheet containing

the detailed instructions for the doing of the work; or sometimes the labor record may be a coupon attached to one of these documents. In cases where the nature of the work requires instruction to be given to the workmen in writing, an opportunity is obviously provided for getting on the same record the information as to his accomplishment of the work.

The work ticket must contain all information necessary for the payment of the workers on the particular wage system in use in the plant. Where piece wages are paid, the number of pieces finished must be recorded, and since in such cases it is important to be sure that all production recorded is good production, space must be provided on the ticket for the o.k. of the inspector who passed the work as being satisfactory. If a task-and-bonus system of payment is in use, the standard time must be shown on the ticket, together with the amount of the bonus, and information as to whether the bonus was earned or not. Sometimes, also, there are small spaces to contain the initials or check mark of the clerk who summarizes or posts the information to the subsequent records, such as the cost sheet for the job, or the payroll account for the men.

SUMMARIZING LABOR RECORDS

When these primary labor records have been written up and turned in at the cost office, the first necessity usually is to summarize them in order that the payroll may be made up promptly for the regular time for paying the men. For this purpose the tickets need to be summarized under the names of the men, a task which may be done on tabulating machines, if they are available. Otherwise, large columnar sheets may be used with a column for each man, in which his work tickets may be entered and totaled. In some cases, adding machines are brought into operation, and the figures for each man accumulated in that way. In any case, the information will finally appear upon a payroll sheet containing the name and number of the workman, the total amount due him, and the detailed information of its composition, in day-work, piece-work, or bonuses. If the business is one in which stores and provisions are supplied to the workers, the charges for which must be deducted from their wages, space for this also must be included on the payroll sheet.

For these reasons the payroll form of a mining company which owns the houses in which the miners live, and the store from which they buy their provisions, will be quite complicated.

The next task to be done is to sort the tickets over again on the basis of the jobs, or processes, or departments, to which they are to be charged. The work of summarizing these job costs will be done by methods similar to those described for the accumulation of the payroll. When the summaries are complete, it is clear that the total amounts shown by the payroll to be due to the men must agree with the total amounts shown by the cost analysis as being chargeable to jobs. This is one of the proofs of the records. Sometimes the payroll itself has attached to it a distribution sheet, upon which the amount due to each man is distributed into certain columns representing the processes or the departments to which it is to be charged. If the operations are such that this is possible, it affords a simple means of tying up the payroll accumulation with the cost records. When, however, the labor costs are not to be charged to processes or departments, but rather to job orders which are very numerous, it becomes impossible to have enough columns to show the distribution of each man's wages in this manner, and rough columnar accumulation sheets are used, without special printed headings.

VI

BURDEN COSTS—ACCUMULATION AND DISTRIBUTION

All expenses which enter into the cost of production of any article, and which have not been included in the direct cost of materials and labor, must be included in the burden charges. The burden expenses must, therefore, consist of a very varied lot of items, most of which have no direct relation to the particular units of product. A certain amount, therefore, of arbitrary division of general expenses over the product cannot be avoided. Nevertheless, methods of procedure have been worked out which, if followed, will give results which are sufficiently reliable for all practical purposes. Many of the rough and ready methods in common use, on the other hand, give very misleading results, and the cost data which are obtained under such circumstances are often most unreliable.

A SINGLE PRODUCT

Let us take a very simple case first, a case in which there is only one product, and that product easy to measure in terms of a definite unit, a coal mine for example. All the costs in the operation of the mine are incurred for the purpose of getting out so many tons of coal. Having computed the costs of direct labor and supplies, and a depletion charge to provide for the reduction of the coal deposits in the mine, all other expenses may be regarded as the mine overhead. If the total amount of them be ascertained, and this total divided by the number of tons of coal produced during the period, a burden cost per ton will thereby be obtained without further computation.

Such a situation, however, is not usually found in a manufacturing plant, especially if there are several products worked upon in the same or different departments. In such case, an intelligent marketing policy can be followed only with reliable cost

figures available for each of the products; and an intelligent production policy can be followed only by having similarly reliable information as to the costs and efficiency of the several manufacturing departments. For this purpose, reliable methods of burden distribution are essential.

DEPARTMENTAL DISTRIBUTION

The first general rule is, that in a plant consisting of several departments, turning out several products, the use of flat percentages, to be added to the cost of each product, is usually not sufficiently accurate. The first requisite is that all burden expenses shall be listed under their several headings and each one divided among the manufacturing departments upon some basis which is equitable for that particular item. Charges like rent and heat, for example, may ordinarily be divided in proportion to the space occupied by each department. Other charges, like insurance, depreciation, property taxes, and interest, may be divided in proportion to the value of the equipment in each department. Indirect labor and supplies should be capable of being allocated to the departments on a basis which represents actual conditions quite closely. Power is frequently metered for the several departments, in which case the actual consumption of each department can be charged to it. Light may be divided in proportion to the number of lamps in each department. If all the other items of expense are similarly treated, one stage in the distribution of expense is thereby accomplished in a manner corresponding closely with the actual facts.

In making this departmental division it will, however, be observed that some of the departments which must take a share of the expenses are not directly productive departments. The factory offices, and the service and administrative departments work for the factory as a whole. In dividing the expenses, it is natural to allocate to these their proper share of such expenses as rent, light, heat, depreciation of equipment, salaries, insurance, and taxes. Since there is no product in these departments which can be charged with these expenses, we can only redistribute their total costs, thus obtained, to the producing departments. This is usually done by dividing the total expenses of indirect departments among the direct departments in propor-

tion to the expenses which have thus far been charged to the direct departments. For example, if the direct expenses of the producing departments have thus far amounted respectively to $10,000 for Department A, $15,000 for Department B, and $10,000 for Department C; and if the expenses of the factory administrative offices total $7,000, then a pro rata division of this amount will give $2,000 to Department A, $3,000 to Department B, and $2,000 to Department C. In this way the total cost of the producing departments of the factory is ascertained, inclusive of non-producing department expenses.

DISTRIBUTION TO THE PRODUCT

Having these expenses now located in the several departments, it becomes necessary to subdivide them in a manner which will charge each job or product of each department with a proper share of the general expenses of that department. For this purpose it is usual to work out rates, by the aid of which the burden charge for each job can be figured in a simple manner. Sometimes these rates are a percentage of some figure which we already have, such as 40% of the direct labor cost or 25% of the total prime cost. At other times, the burden rate may be expressed as a cost per hour, such as $1.50 for each hour of direct labor upon the job, or $4 for each hour of a machine's time on the job. The computation of these rates can be briefly explained by examples.

1. *The Labor-Cost Rate.* If the direct labor cost of Department A amounts to $15,000 in a year, and if all the burden expenses allocated to it amount to $12,000, the burden is equal to 80% of the direct labor cost, and this percentage may be used on individual jobs done in Department A.

2. *Direct Labor-Hour Rate.* If in the same department the total number of hours which were worked by the direct work people amounted to 16,000 hours, this would give us an hourly rate of 75 cents. That is to say, if we have the number of hours which have been spent upon any job, and multiply that number by 75 cents, a proper charge to that job for burden expenses will thereby be obtained.

3. *Prime-Cost Rate.* This is obtained by a computation similar to that for the labor-cost rate. If the materials used in the above-mentioned instance are worth $15,000, this amount, with the labor cost, makes a total prime cost for the department of $30,000. The $12,000 of expense then gives a rate of 40% of the prime cost. If then the direct labor and material costs of a job amount to $12, $12 multiplied by 40%, or $4.80, is the amount to be added to that job for burden.

It is not very common to include the material costs in the base for calculation of burden rates. More often they are calculated upon the labor figures, upon the ground that the expenses are incurred chiefly for the purpose of providing and maintaining suitable working conditions and equipment for the work people. As to the difference between the labor-cost basis and the labor-hour basis, it may be noted that many of the items which go into burden accumulate on a time basis; rent, depreciation, taxes, insurance, interest, and administrative salaries normally accrue regularly every day. For this reason it is usually the fact that a time basis for burden distribution is more satisfactory than any other. Nevertheless, the labor-cost basis is frequently used because the figures of labor cost must, in any case, be computed for the payroll, and are, therefore, available; and the amount of difference between this rate and the labor-hour rate is sometimes not sufficient to warrant more trouble being taken.

MACHINE RATES FOR BURDEN

Recently cost accountants have been more and more impressed with the fact that burden expenses in modern plants arise from the provision and operation of expensive equipment. The cost of making any article in a modern factory is very largely the cost of providing and running a machine for the period which it takes to make that article. For this reason the use of machine-hour rates has come into favor, and they will probably be still more widely adopted as they become more generally understood.

A machine-hour rate is calculated approximately as follows:

1. The fixed charges and operating expenses of the whole fac-

tory are subdivided among the departments in the manner already described.

2. The total expenses thus allocated to a department containing machines will be subdivided by similar methods among the various machines within the department.

3. Assuming that machine Number 15 is in this way found to cost $3,600 per year to maintain and operate, and assuming that its activity, within a year, will amount to 1,800 hours, we arrive at a cost per hour of $2. If, then, any job occupies this machine for a period, say of five hours, the amount of burden to be charged to that job would be $10.

There are many variations of the machine-hour rate to be found in practice. In some industries a departmental hourly rate is computed which includes both direct labor and burden. The rate is spoken of as the "sold hour rate," the idea being that the department sells its services at so much per man-hour, or per machine-hour. This figure would include not only the wages of the workman but also the cost of maintaining and equipping him for his work. A common example of this sort of thing is the garage repair department, which charges customers, say, $1.50 per hour for the mechanic's time spent on repairs. This charge includes the mechanic's wages, a share of the general overhead expenses and (since this is a charge made to customers) a profit. In order to get the strict cost rate, the profit would, of course, have to be eliminated. Another example is to be found in the printing trade, which computes the cost of setting type for one hour by hand composition, the figure including the compositor's wages and also a share of the department overhead: similar rates are computed for other departments of the establishment. The furnace-hour rate explained in Problem Number 11, on page 226, is of the kind here described.

USE OF BURDEN RATES

We have so far been describing the methods by which burden rates are computed. It is necessary next to show how these rates are used in the actual distribution of the burden. For this purpose a very brief example, in which the original expenses are carried through all stages, will probably serve most clearly.

The cash payments for the actual burden expenses of a plant are represented by the following journal entries:

Supplies	$2,050	
Supervision	3,600	
Taxes	1,300	
Insurance	300	
Rent	1,500	
To Cash		$8,750

In addition a provision for depreciation might be made, thus:

Depreciation on Equipment	$1,000
To Reserve for Depreciation	$1,000

These entries will be posted to the ledger in the usual way. Assume that the expenses had at the beginning of the year been estimated at the following amounts:

Item	For the Year	For One Month
Supplies	$ 24,000	$ 2,000
Supervision	42,000	3,500
Taxes	18,000	1,500
Insurance	6,000	500
Rent	18,000	1,500
Depreciation	12,000	1,000
	$120,000	$10,000

It is desired to use burden rates based upon normal, average conditions, and excluding temporary fluctuations: in other words, burden will be charged at "standard" rates. These rates will, therefore, be calculated from the estimated amounts above, not from the actual cash disbursements. Another good reason for doing this is that such rates must be calculated in advance; we cannot wait until the actual costs of the month are known: on the contrary, it is necessary to have a rate for burden which can be used in calculating the burden cost of each job as it goes through during the month.

The first stage in the process of distribution is the distribution of expenses to departments. Each item of general expense is subdivided upon a basis which represents the actual conditions as nearly as they can be ascertained. For example:

Supplies might be divided between the departments in proportion to their actual use of such supplies as shown by previous records.

Supervision. In so far as this item includes persons like foremen, inspectors, and others whose work is entirely within one department, the amounts chargeable to each department can be exactly ascertained. In so far as the amount includes general supervision of all departments, it can be divided between them in proportion to the number of work people employed in each department, or to the total payroll of each department. This obviously is on the assumption that the supervision expense is a cost of managing the workers and will, therefore, be in proportion to their numbers.

Taxes will be apportioned to the departments in proportion to the value of the investment in each. This refers to property taxes which are levied upon the value of the property. Income taxes are not a cost of manufacture but a charge against surplus.

Insurance also is distributed to the departments in proportion to the value of their properties, since it is upon this value that the insurance premium is calculated.

Rent is divided between the departments in proportion to the floor space occupied by each.

Depreciation, being calculated upon the value of the property, will, like Taxes and Insurance, also be allocated to departments in proportion to the value of the equipment in each. The results of this division of expenses are shown in the following table:

MONTHLY DISTRIBUTION OF EXPENSES

Items	Total	Dept. A	Dept. B	Dept. C
Supplies	$ 2,000	$ 600	$ 900	$ 500
Supervision	3,500	800	1,600	1,100
Taxes	1,500	400	700	400
Insurance	500	100	300	100
Rent	1,500	500	600	400
Depreciation	1,000	200	500	300
	$10,000	$2,600	$4,600	$2,800

From this table the following journal entry will be made:

Dr. Dept. A, Work in Process	$2,600	
Dept. B, Work in Process	4,600	
Dept. C, Work in Process	2,800	
Cr. Supplies		$2,000
Supervision		3,500
Taxes		1,500
Insurance		500
Rent		1,500
Depreciation		1,000

This journal entry is made upon the books at the end of every month and is the accounting record for the distribution of the general burden to the departments.

The next step is to devise a method by which the expense of Department A may be charged to the products of that department, and for this purpose a rate is calculated. We will assume that in Department A it is believed that the burden can be distributed most accurately by using labor-hours as the base. Assume that the normal number of payroll-hours in this department is 1,625; dividing this number into $2,600, the amount shown as the total burden of this department, a rate of $1.60 is obtained. This means that for every hour of labor shown on the cost sheet of any job there will be added $1.60 for burden. For example:

If job Number 135 has 10 hours of direct labor put on it, the burden charge to that job would be $1.60 × 10 = $16.

At the end of the month these job costs would be summarized, and this would tell us exactly how much burden had been charged during the month to jobs. This amount would then be credited to the Work in Process Account, Department A, and charged to Cost of Sales, Department A. In this way the work of distributing the burden to the product will have been completed.

UNDISTRIBUTED BALANCES

Certain balances, however, will remain in some of the accounts at this stage, representing maladjustment at various points in the procedure. For example, the actual amount of money spent under the several headings of expense, and debited to the accounts, will differ somewhat from the average or normal amounts

which have been credited to the same accounts. In other words, there is a difference between the actual figures for expenses incurred and the standard figures which have been used for the purpose of calculating burden rates.

Thus, Supplies might show a debit balance of $50; Supervision, a debit balance of $100; Taxes, a credit balance of $200; and Insurance, a credit balance of $200. Rent and Depreciation accounts normally show no balance because these are items which can be known exactly in advance.

If through the whole year the actual expenditures on the other items of Supplies, Supervision, Taxes, and Insurance should turn out to be exactly as estimated, the small balances in these accounts would disappear. In some months there would be no payments for taxes; in other months there will be payments of some one tax for perhaps the whole year. It is likely that there will be small discrepancies at the end of the year, however, represented by balances in these accounts, and the way to dispose of them is to transfer them to Profit and Loss account at the end of the fiscal year.

It will next be noticed that Work in Process account, in so far as it relates to burden, may also show a balance which represents a maladjustment. This is due to the fact that we assumed that Department A, for example, was going to have 1,625 payroll-hours, for each of which we should charge $1.60 to the jobs, which would have given an amount of $2,600 to be credited in the account. Suppose it transpired, however, that the department did not work 1,625 hours, but only 1,500 hours; the credit then would be only $2,400, leaving a balance of $200. This is commonly spoken of as unabsorbed burden due to idleness. It represents the expenses which have accumulated in that period of time during which the department failed to operate. It is the general opinion that, except in unusual circumstances, such an expense should not be charged to the cost of product but should be charged to Profit and Loss account.

In practice the monthly distribution of burden expense is, of course, a much more complicated matter than the simple one shown. Form 6 shows a somewhat more complete example. A form of this general type may be used in every industry which desires to distribute burden on departmental lines; the procedure is much simplified thereby.

Total Amount	ACCOUNT	Selling Expense	General and Office	Factory General	Hand Composition	Machine Composition	Job Presses	Small Cylinder Presses	Large Cylinder Presses
$10,400	Payroll	$100	$300	$200	$2,605	$1,410	$1,700	$1,945	$2,140
200	Electricity	5	5	10	20	40	40	40	40
400	Manufacturing Supplies and Expense	...	...	...	40	100	80	70	110
100	Spoilage	...	...	...	10	10	30	20	30
490	Rent	10	30	40	90	70	100	60	90
350	Insurance	...	20	20	60	70	50	50	80
400	Taxes	...	30	30	70	80	50	50	90
450	Depreciation	...	40	40	70	80	60	60	100
270	Interest on Plant Investment	...	10	10	40	60	40	40	70
500	Selling Expense	500	...	...	...	...	...	...	...
100	Advertising	100	...	...	...	...	...	...	...
200	Shipping and Deliveries	...	200	...	...	...	...	...	...
900	Executive Salaries and Expense	200	400	40	50	50	50	50	60
320	General and Office Expense	20	300	...	...	...	...	...	...
280	Reserve for Overhead	...	...	...	60	50	50	60	60
40	Reserve for Bad Debts	...	40	...	...	...	...	...	...
	TOTAL DIRECT DEPARTMENTAL	...	...	...	$3,115	$2,020	$2,250	$2,445	$2,870
	Total Factory General	...	...	$390	95	60	70	75	90
	TOTAL FACTORY COSTS	...	...	...	$3,210	$2,080	$2,320	$2,520	$2,960
	Total Selling Expense	$935	935	...	...	...	...	...	...
	Distribution of General Expense	...	$2,310	...	570	370	410	440	520
$15,400	TOTAL DEPARTMENTAL COSTS	...	...	...	$3,780	$2,450	$2,730	$2,960	$3,480
	Chargeable Hours	...	...	...	1,990	6805	1,092	925	810
	Cost per Chargeable Hour	...	...	...	$1.90	$3.60	$2.50	$3.20	$4.30
	Average for 3 Years Past	...	...	...	1.80	3.40	2.40	3.00	4.00

Adapted from the form used by the United Typothetae of America

Form 6: Printers' Monthly Distribution of Expenses

COMMENTS ON FORM 6

The following observations might be made in addition to those which have been given on the subject of the distribution of items of expense burden between the departments. Form 6 represents the distribution of expenses in a printing shop; in this industry it is the practice to combine the direct labor cost with the burden expense. For this reason, payroll is included in the monthly distribution of expenses and in the hourly rates which are worked out therefrom. These hourly rates are not, therefore, burden rates only. They are "sold-hour rates" of the sort to which reference has already been made.

Electricity is probably for Light and Power. Where it is a comparatively small amount like this, the item of Light will be divided among the departments in proportion to the number of lamps in each; and Power is divided in proportion to the rated horse-power of the several machines in each department. Machines are usually marked with the horse-power which they consume when running, and this horse-power rate, taken for all the machines, can be used as a basis for calculating the amount of power chargeable to each department. If it is thought that this is not sufficiently accurate, by reason of the fact that in one department the machines stand idle a good part of the time, and in other departments they run continuously, it would be desirable to modify this calculation by taking the relative activity of the machines into account. The following simple example will show how these calculations might be made, assuming that there is a monthly power bill of $1,914 to be distributed.

Department	Total Rated H. P., All Machines	Full Time Hours per Month	% of Full Time Run, Average	H. P. Hours per Month, Average	Charge to Departments
A	30	200	70	4,200	$ 252
B	90	200	60	10,800	648
C	40	200	80	6,400	384
D	70	200	75	10,500	630
Total	230			31,900	$1,914

If power is a very considerable item, the company might install meters to ascertain exactly how much power is consumed by each machine or each department. This supplies the infor-

mation for an exact division of the power costs—and it might here be mentioned that these methods of division will, under the circumstances named, apply equally well to the distribution of a power charge consisting of a bill from an outside power company, or of an amount which represents the total expenses of running a power plant on the company's own premises.

Spoilage. In some plants there is considerable loss from the spoilage of work due to mistakes and carelessness of the work people. If this is a factor, then figures will be kept showing the costs and amounts of spoilage occurring in the several departments. This will enable us to estimate the amount of spoilage which is likely to occur in one year, and also to distribute it between those departments in which it is likely to occur.

Insurance. When this item consists of workmen's compensation insurance it is usually divided between the departments on the basis of the payroll costs, or at a fixed rate per man.

Redistribution of Nonproducing Department Costs. A further step is necessary in Form 6 by reason of the fact that some of the burden expenses are charged first to selling expenses, the general office, and the general factory offices. This requires a redistribution of these amounts to the departments which are directly productive. General factory expense is usually redistributed in proportion to the direct costs already charged to the productive departments; though sometimes the division is made in proportion to the departmental payrolls, on the assumption that general service and supervision are incurred for and in proportion to the amount of labor involved.

Commercial overhead, consisting mostly of selling expense, is a somewhat different matter. There is no direct relation between selling expense and the cost to manufacture, yet because of the convenience of the procedure, the former is sometimes applied on the basis of the latter. This is what has been done in Form 6. If this basis of distribution is judged to be too far removed from facts, then the total selling value of the products of the different departments may be used. But where the different departments are not producing different products, but only contributing to the same product, such a method involves arbitrary calculations which make the value of the results very doubtful.

On the other hand, if different products emanate from the different departments, it may be possible to tell how much advertising and other selling effort applies to each product, and so get an apportionment of selling expenses on an actual basis, which is always the most desirable thing if it can be done.

Increasing attention is being devoted to the matter of proper accounting for selling and administrative expense; the large amounts spent for these purposes deserve the same careful analysis as is given to manufacturing costs. Many firms have made studies of what it costs to sell different products, to get orders for different amounts, and to make sales through different methods of marketing; on the basis of such studies it is possible to show an apportionment of selling expense which will be reasonably correct.

VII

COST SUMMARIES AND ACCOUNTING CONTROL

THE methods have been described by which individual items of cost, such as labor, material, and burden for one job are shown. It is now necessary to indicate how these various items of cost are summarized in order to show such information as the total cost of one job, or the total costs of the entire product for one month. For this purpose, examples will serve better than general description.

Form 1, in Chapter II, shows the method by which the total cost of one job is accumulated in the printing industry. It will first be observed that all particulars relating to the order are shown at the top of the form. This form, commonly called the "Job Cost Sheet," is sent into the shop enclosed in the envelope which gives instructions to the shop to do the actual work. The subject matter to be printed must, of course, accompany this form. In the spaces for paper, bindery materials, ink, and miscellaneous purchases, the value of the actual quantities of these materials which are used on this particular order will be entered at the time when they are taken out of stock. Under the heading of "Labor and Overhead" are shown the various departments of a printing shop, such as hand composition, machine composition, job press, and so forth. For each of these departments a sold-hour rate, previously worked out, is in effect. Thus, for hand composition the rate might be $2.25; so that if the job occupied 10 hours of the compositor's time, the total charge would be $22.50 for this item. The compositor's wages might be only 75 cents an hour, or $7.50, which would mean that the remainder of the charge, namely $15, would represent the amount for burden. In this way the total cost is ascertained, and, by comparing this with the selling price, the profit or loss on the job is shown.

This form is then used for another purpose; it is the record from which the costs are copied into a "Sales Register and Analysis of Costs." This record is a regular account book of original

entry, from which the monthly totals will be posted to ledger accounts. It is by this means that the total costs of completed work are credited to Work in Process account and charged against Sales in the general ledger; and, since there is a column for each item of cost, this same record provides the information for corresponding postings to the cost ledger. To sum up, this form serves the following purposes:

1. It is a cost sheet showing the accumulation of the cost of the job.
2. It is the medium for recording particulars of the costs of the job in the account book of original entry. This book of original entry, posted in monthly totals to the ledgers, completes the monthly summary of cost information.

The sales register referred to contains columns for the following items:

Paper	Hand Composition	Bindery C
Bindery Materials	Machine Composition	Bindery D
Ink	Job Press	Total Cost
Miscellaneous Purchases	Cylinder Press	Selling Price
Handling Costs	Cutting Machine	Profit or Loss

With one job on every line of this record, monthly totals will be obtained showing the total amount of each item of cost for all which have gone through during the month. From these totals the following postings can be made:

IN GENERAL LEDGER

1. Debit Cost of Sales
   Credit Work in Process (the factory control account)
   (with total cost of all orders completed during month)
2. Debit Accounts Receivable
   Credit Sales
   (with total value of sales for month)
3. Debit Sales
   Credit Cost of Sales
   (with balance of latter account)
4. Debit Sales
   Credit Profit and Loss
   (with balance of former account)

We now have on the general ledger the total profit or loss on all business done during the month; and in the sales register the

profit or loss on each job is given. In addition to the above postings in the general ledger, the several cost ledger accounts for Paper, Bindery, Ink, Hand Composition, and so forth, will be credited with the totals of their respective columns in the sales register, to correspond with the credit to Work in Process account in the general ledger shown in entry Number 1 above.

A MONTHLY COST SHEET

Form 7 shows the cost sheet which is used by a prominent manufacturer of rubber shoes. In this case the product is a standard article made in large quantities for stock; there is, therefore, no purpose to be served by trying to find the cost of each individual customer's order; the practice is to get the cost of the entire production of the whole month upon a form like that shown.

On this form, it will be seen that after the various materials have been recorded, a deduction is made for sale of old material. This represents the credit made to the costs for scrap material. Since the item is comparatively small in value, it will probably be recorded at the selling price of the scrap material, thus avoiding the trouble of calculating any cost or profit upon the scrap.

The next item on the cost sheet—Difference in Material in Process—shows the change which has taken place in Material in Process account since the beginning of the month. If the balance is less at the end than at the beginning, the item will be added to the costs of this month; if the balance is larger at the end of the month, the difference constitutes a subtraction from the monthly cost. The same remarks apply to the corresponding accounts—Difference in Labor in Process and Difference in Overhead in Process. It is clear, further, from the presence of these three items on the cost sheet, that the total amount of work in process in the factory is represented by three accounts in the ledger: namely, Material in Process, Labor in Process, and Overhead in Process.

From the columnar headings, it will be observed that the sheet is intended to show the standard cost as well as the actual cost of each item. It is evident, therefore, that a system of standard costs is in operation, and that a standard figure for every item of cost has been established. These standard figures are prob-

Comparison of Actual and Standard Cost of Production
WATERPROOF FOOTWEAR

Factory _____ Month of _____

Item	Actual Cost	Standard Cost	Purchase Variation	Efficiency Variation	Total Variation
MATERIAL					
Rubber					
Reclaimed					
Dry Goods					
Chemicals					
Sundries					
Total Material Issued					
Less Sale of Old Material					
Difference in Material in Process					
Total Material Consumed					
LABOR-Direct					
Piece					
Day					
Bonus to Piece					
Overtime to Day					
Cost of Instruction					
Total					
Difference in Labor in Process					
Total Labor Consumed					
OVERHEAD					
Factory Expenses, Salaries and Wages					
Factory Expenses, other than Salaries and Wages					
Total					
Difference in Overhead in Process					
Total Overhead					
TOTAL Cost of Production					

Over or under-absorbed overhead _____

Form 7: Monthly Cost Sheet for Rubber Footwear

ably based upon previous experience, corrected for any changes which are anticipated in the near future. By means of these standard unit costs, and the number of units produced during the month, the standard figures for the second column on the form can be computed. The first column shows the actual cost which was incurred for each item during the month. The difference between these two columns is shown in the fifth column—Total Variation. This total variation is composed of two things:

1. More was paid per unit during the month than the standard figure, and this might apply equally upon materials, labor, or expenses.

2. A larger quantity of material, or a longer period of labor, may have been used in making the product than was allowed for in the standard.

The former of these items is what is called Purchase Variation in the third column of the sheet, and the second item is shown in column four as Efficiency Variation. In obtaining these figures the purchase variation is calculated first. The actual price paid per unit and the standard price per unit of each item are available; by multiplying each of these by the quantity produced and finding the difference, the purchase variation is obtained. Subtracting this from the total variation, the efficiency variation for the fourth column is found.

A monthly cost sheet of this general type (though not necessarily with standard costs) will probably be used wherever a standard product is manufactured, and especially where process costs are used. In making calculation, therefore, on such things as cement, or coal mining (see Form 2), we should expect to find a monthly cost sheet in which the total amount of each item of expense incurred during the month will be shown, and the same is true of chemicals, food products, soft drinks, leather, and a great variety of other products.

A UNIT COST SHEET

Still another type of cost sheet is shown in Form 8. This form also is to some extent based on the use of standard costs and may be used either to calculate the cost per yard of a fabric which has been made, and upon which actual data are available, or to estimate the cost of a fabric which it is proposed to make. In the latter case the amount of time which will be taken on each operation will be estimated, and the standard costs for those operations applied. In this way a fairly close figure may be obtained before any of the cloth has been made, though it sometimes happens that the time estimates made in advance of actual running do not prove very trustworthy. The labor charge for each operation is shown in the first money column, and in the

DETAILED FABRIC COST

Construction	Yards per cut	Pounds per cut	Loom	Style	Speed
Warp Ends Percentage	Filling	Warp Ends Percentage	Looms per weaver		
Percentage Seconds	Pounds per spindle-week	Spinners per loom	Number of harnesses		

Dates	Labor	Overhead			
Weaving expenses per loom-week of 48 hours					
Weaving piece price per cut					
Warp drawing price per beam					
Percentage loom production					
Production pounds per loom-week of 48 hours					
Production yards per loom-week of 48 hours					
Manufacturing cost, warp per pound of cloth					
Manufacturing cost filling per pound of cloth					
Slashing cost per pound of cloth					
Warp drawing per pound of cloth					
Weaving piece-work per pound of cloth					
Weaving expense per pound of cloth					
Cloth room cost per pound of cloth					
Extras, loss on seconds, etc., per pound of cloth					
Total cost except cotton per pound of cloth					
Cost warp Stock per pound of cloth					
Cost filling Stock per pound of cloth					
Total cost per pound of cloth					
Total cost per yard of cloth					

Reproduced from the report of the Cost Committee of the National Association of Cotton Manufacturers

Form 8: To Compute Cost of One Yard of Fabric

next column the corresponding overhead is shown, being in each case a percentage of the labor cost, the percentage varying for each department. At the bottom, the Total Cost Except Cotton per Pound of Cloth is shown. To this the cost of cotton used is added in two items—the Warp, or lengthwise threads, and the Filling, or crosswise threads. This enables us to calculate the Total Cost of Cloth per Pound, and by dividing this by the number of yards in a pound, we are able to get the total cost per yard of cloth.

It is very common for cotton manufacturers to keep cost records of this kind, with one card for each different pattern of cloth, but sometimes they do not proceed further with the summarizing of costs for the purpose of making actual ledger records of the cost data. In other words, they will keep their ledger accounts by non-cost accounting methods, but will have this cost information as memorandum records not tied in with the general ledger accounts.

METHODS OF COST SUMMARY

Three general methods of summarizing cost information have now been referred to:

1. The job records may be entered in a book of original entry, classified in suitable columns as in the case of the printing system, the totals of which columns will be the monthly summary figures to enter in the ledger accounts.

2. It may not be feasible to keep individual job costs; or if they are kept, it may not be convenient to record them in a book of original entry for purposes of summarizing. In this case it is probable that the original cost data such as labor tickets, or the payroll totals made up from them, and the material requisitions, will be summarized on adding machines and comptometers, and in this way the total monthly costs, properly classified, will be secured. These totals will be formed into journal entries, and thus the costs of products will be incorporated on the books.

3. In many cases in practice, data will be kept of individual job costs or unit costs, but without summarizing this information into totals which can be used upon the ledger.

The last-named case raises the question as to how necessary it is that the cost information should be made to tie up with the regular financial accounts in a way to become part of the double entry system of financial accounting. The general belief of accountants is that this should be done wherever possible. It is found that records which are kept purely as memoranda, and are not checked up by being incorporated in the double entry system, in practice are prone to deviate more and more from the actual facts, and it is difficult to bring these errors to light. Carelessness in their use is apt to develop, and in many cases such records will become so obviously unreliable that they will be abandoned in disgust. If, however, the cost records are tied in with the financial books, and the transfers within the factory recorded in total in the accounts, any discrepancies will be revealed and will call for explanation. In this way the cost accounts are subjected to a continuous check; it is the actual disbursements as shown by the financial records which must be fully accounted for in the cost records; and the results secured are far more likely to be dependable.

A little extra trouble is usually necessary in order to bring the cost system to the point where it ties up with the financial records, though after practice little difficulty will be experienced in doing this. It is chiefly a matter of instructing the bookkeeping staff in the few extra steps, some of which, though not difficult to one practiced in them, are often beyond the range of ordinary bookkeepers.

Problem Number 7, in Chapter I, the Murdock Sash and Door Company, indicates what total figures would be assembled from the cost records, and how they would be incorporated in the accounts.

VIII

STANDARD COSTS

THE most considerable development in cost method in recent years has probably been the introduction and wider use of standard costs. This expression has been used a number of times already, but the subject is important enough to deserve special treatment.

By "standard cost" is meant the cost of production of an article, based upon normal, or average, or estimated figures and conditions. Usually the standard costs will be the best possible estimate, made in advance, of what the actual costs are going to be. This phase of the matter is better emphasized by the use of the term "predetermined" costs, which is frequently used in cost literature and usually means the same as standard costs. The purpose, then, is to set up the standard costs, and to compare the actual costs with them as the period elapses for which the estimates were made. It follows that standard costs are properly and conveniently associated with the use of budgets. Every budget cannot be supplemented by a system of standard costs, but, where it is possible to do so, the effectiveness of the budget system will be increased if the budget figures can in some way be incorporated in the accounts as standard costs, from which all deviations will then show up very clearly upon the books of account.

PROCEDURE FOR SETTING STANDARDS

A system of standard costs requires that complete schedules of the product should be made in advance, with an estimate for each item of expense connected with each item of product. These estimates will ordinarily be made by taking the actual figures for the previous years and correcting them to agree with the anticipated conditions of the coming period as closely as possible. It is also necessary, either to estimate the quantity of product likely to be turned out, or else to take the normal or average

product, based upon the experience of a number of years. Sometimes, in fact, the costs themselves, rather than being the estimates of what is likely to happen during the coming year, are made to contain normal or average cost figures over a period corresponding to the business cycle. If this latter method is followed, the cost records kept will show the deviations of actual figures from the normal; but if the standard figures are made to consist of the best estimate for the coming year, then the cost records will show the extent to which the actual results have departed from these estimates for the year. It then becomes a question as to which of these two comparisons is more serviceable to the management. In answering this it may be observed at once that the normal figures, say of a five-year period just passed, naturally will not coincide with the estimated figures for the coming year, so that if the former figures are used, the standard costs will not represent the budget, in case a budget is in operation. Many believe that the comparison of actual figures with the estimates which were made of what those actual figures would be, is of more immediate use and importance than to compare the actual figures with an assumed normal figure. The war period, they say, with the subsequent boom and depression, has made normal figures difficult to arrive at. But in spite of the probable greater reliability of normal figures in the future, some people declare that they are more immediately interested in the figures of the current year, estimated and actual.

WHAT BASE SHALL BE STANDARD?

This discussion will perhaps be clearer from the following table, giving production figures for 1922, for a five-year average, and the estimated figures for 1923. It is proposed to set stand-

	1922 Actual (1)			Five-Year Average 1918-1922 Actual (2)			Estimated 1923 (3)		
Product Number	Number	Value	Per Unit	Number	Value	Per Unit	Number	Value	Per Unit
1	2,800	$12,600	$4.50	3,000	$15,000	$5.00	3,100	$14,880	$4.80
2	3,400	13,600	4.00	3,800	17,100	4.50	3,800	15,960	4.20
3	1,900	16,200	8.00	2,200	19,800	9.00	2,300	19,550	8.50
4	2,400	21,600	9.00	2,800	28,000	10.00	2,900	27,550	9.50
	10,500	$64,000		11,800	$79,900		12,100	$77,940	

ard costs. The question is, shall we use the average figures in column 2, or the estimated figures in column 3, as the base? Although there can be no doubt of the great importance of the relation between the actual figures and the normal, yet the uncertainty of the normal for one single business makes the comparison a somewhat indefinite one, at least a difficult one to make. The estimated figures for the coming period based on the best information which is now available, constitute a more definite standard of measurement and the results are likely to be more reliable and more immediately serviceable in showing how accurately the budget estimates have been made.

On the other hand, if we could assume that the normal figures were reliable, then a comparison of the actual figures with them would be of great value for indicating the present position of the business in regard to the business cycle, how far the business is removed from its base, so to speak, and in what direction. This comparison would be of little value in checking up estimates, but it might be of still more value than the other comparison for the purpose of showing what direction the future trend of the business is likely to take. For this reason many business men favor the use of the normal figures as the standards.

The importance of the discussion as to the output which shall be used in calculating the standard costs arises in connection with the burden; the standard output, or the standard number of running hours, being the quantity which is divided into the total burden costs in order to obtain a unit cost for the burden.

STANDARDS FOR SEPARATE COST ELEMENTS

Standard costs may be used in the cost accounting for material or labor or burden; the costs for all or any of the three may be on the standard basis. In view of the considerable fluctuations which arise in the market prices of raw materials, this is the element of expense which is more usually accounted for on the basis of actual costs; many manufacturers think that the standard costs, unless they are changed frequently, will be apt to depart too much from the actual figures; and frequent changing is practically an abandonment of the standards. Labor rates, on the other hand, change much less frequently in most industries and are therefore more easily converted into standard figures. Bur-

den expenses are for the most part still more fixed in their character, and standard rates for burden can therefore be set in advance with a high degree of accuracy. Moreover, the use of standard costs for burden is almost unavoidable for two reasons; the first being that, on account of the indirect methods by which burden must be calculated, it would involve great difficulties and delay to try to use actual figures, and the second is, as already indicated, that the question of the normal output and the amount of idle time enter very largely into any question of the correct determination of burden.

MATERIAL COST STANDARDS

In establishing standard costs for materials, it is necessary to take the scheduled quantities of materials necessary to produce the article, making suitable allowances for waste or scrap. The quantities thus set as standard should represent a high level of skill on the part of the workmen, in order that any departures from the best possible practice may be revealed by the cost records. For example, if 100 pairs of uppers for a certain type of shoe could be cut by a highly skilled workman from a certain quantity of leather, that quantity should be the standard, so that if another workman uses more than this quantity of leather in the same product, a comparison with the standard will immediately indicate the extent of his lack of skill.

In the case of a machine product which is assembled from many parts, the drawings and engineering schedules will form the basis for the standard quantities to be used for making the several parts.

It is then necessary to consider what standard prices shall be attached to these standard quantities of materials, to complete the establishment of unit costs. It is at this point that market fluctuations in material prices will cause difficulty. The purpose is to choose such prices as will afford the best basis of comparison with the actual figures when the latter shall be ascertained. For this purpose most people consider it desirable to use the best estimate of the price which they will probably have to pay during the coming period, in other words, the same figures as are used in compiling the budget figures for materials. Some accountants, however, prefer to figure a normal cost, based upon their aver-

age experience during the previous years, in order to indicate how far from normal they are.

LABOR COST STANDARDS

Standard figures for labor are more easily obtained. If it is the practice to pay piece rates, then these piece rates are the standard rates, and there will be no variation from them unless the rates should be changed during the period, in which case it is necessary to consider whether the standards themselves should not also be changed to correspond. Where time wages are paid, time studies are usually made in order to ascertain the amount of time necessary for each operation to be performed by a workman of a reasonably high degree of skill. The standard should not be an impossible one, nor one which will be reached only very unusually, but if it is set at a figure which can be reached by good work people, it becomes a mark at which the whole body of employees can aim with reasonable hope of success. Such standard times, converted into money at the rates of payment in force, will supply the standard costs for labor.

BURDEN COST STANDARDS

In figuring standard burden rates, any one of the methods of burden calculation described in Chapter VI may be used, and standard rates worked out to correspond. Thus, if burden is being distributed by the labor-hour, then a standard hourly rate of burden will be calculated from the same estimated figures upon which the labor costs were calculated. Thus, if the estimated burden costs for the coming period amount to $20,000 and the estimated number of payroll-hours is 25,000, this will give an hourly rate of 80 cents. Then if a certain article shows a labor cost of four hours at $1 per hour, according to the standard labor schedules, the standard burden will be $3.20. Similarly, with machine rates the total machine expenses will be computed; this amount will be divided by the appropriate number of hours—probably the normal or average running time—and an hourly rate worked out like any other machine rate. Then a schedule will be made showing the standard times for which the various operations will occupy this machine, and the standard amounts of burden for those operations will be fixed accordingly.

VARIATIONS FROM STANDARD

The only purpose of going to all this trouble to set standard figures is to enable comparisons to be made effectively with the standards, and unless the variations which arise are adequately explained, the work is so much lost motion. It is necessary, therefore, that actual costs shall be kept as the period elapses, together with statistics as to actual output, and comparisons made from time to time in such form as to show the causes of the differences which have occurred.

If differences arise on material costs, they will be due to one or both of two causes; either the prices paid for the materials will have been higher or lower than those which were used in the standards, or else more or less materials will have been used than were allowed for in the standards. Differences between standard and actual figures for labor will be due to precisely the same reasons; either higher or lower rates of pay will have been made to the work people than were used in figuring the standards; or else they will have taken more time, or less, to do the various operations than was used in computing the standards.

In the case of burden, the situation becomes somewhat more complicated. Three possible factors may appear:

1. Expenses which enter into burden may have amounted to more or less money than was anticipated.

2. The amounts of burden charged to the product may vary from the standards because the base on which the charge is made has varied. For example, if burden is charged at $1 per labor-hour and a certain job is scheduled to be done in five hours, the standard amount of burden would be $5. But if the workman actually took six hours on the job, then $6 of burden might be charged to the job to correspond. This factor, however, might be eliminated by charging the job with the standard amount of burden, regardless of variation in other factors of cost.

3. The third cause of variation would arise when the amount of output realized varied from the estimated quantity. If 20,000 units of a certain product were expected to be completed, and the standard burden per unit was $1.50, this would absorb, in the standard product, $30,000 of expense burden. If, however, only 18,000 units were turned out, then $27,000 of expense burden

would be charged to the work produced, and $3,000 would be left unabsorbed.

A Cost Sheet in which this kind of comparison between standard and actual figures is shown appears in Form 7 on page 48.

It must be understood that in the accounts these variations will actually appear as differences between the debits and credits on the Material, Labor, and Burden accounts. Ordinarily the actual costs incurred will be debited in these accounts, and as the work progresses these same accounts will be credited at standard figures, which standards will be charged to Work in Process. The question therefore arises as to the disposition of the balances which arise in this manner, and the answer to that question is that they will be transferred to Profit and Loss. That account will, therefore, appear something like the example:

PROFIT AND LOSS

Jan. 31	Labor Adjustment	200	00	Jan. 31	Sales	19,300	00
Jan. 31	Burden Adjustment	4,100	00	Jan. 31	Material Adjustment	135	00
Jan. 31	Balance to Surplus	15,135	00				
		19,435	00			19,435	00

The meaning of these items can be briefly explained. The $19,300 brought from Sales is the balance of that account after charging to it the cost of goods sold at the standard figures. Assuming, therefore, that the goods were sold at the prices originally fixed, this amount represents the standard profit on the actual goods sold; if there had been any variation in selling prices, then the difference between standard and actual prices is included in the amount of profit here shown.

The $135 brought from Material Adjustment is an extra profit arising from the fact that the material costs of goods sold were this much less than those shown in the standards.

On Labor and Burden accounts, on the contrary, there were losses from the same cause. On the former account the actual costs exceeded the standards by $200, and on the latter account the excess was $4,100.

The meaning of these balances has been already explained.

It may here be reiterated with advantage, perhaps, that they may be due to variations either in money costs, or in the quantities involved. In the case of Burden especially, the comparative size of the balance would indicate that it is largely due to idle time; that is, the quantity of goods manufactured, and on which the standard burden has been charged, has been considerably less than that on which the burden rates were calculated, thus leaving an appreciable amount of unabsorbed burden.

The value of standard figures in cost accounting is now generally admitted by cost accountants, industrial engineers, and all who have to do with the control of manufacturing operations. Differences of opinion arise, however, as to the form which the standard costs should take, the degree of detail which should be introduced, and the question as to whether the standard figures should be incorporated in the books of account, along with the actual. No general answer can be given to these questions except the vague one which is always given; namely, that the records should be made in such detail as to give all information that is considered useful, provided it does not involve too much trouble and expense. Here again, however, it must be remembered that, provided the standard system is well planned, most of the trouble will arise when it is first being installed. It can be reduced to a routine procedure which will run just as smoothly as other systems of accounting which do not involve standards.

There is, however, considerable opinion to the effect that adequate control will be secured if standard quantities of material are set for making the various products, and standard labor times established to correspond, without showing the money values. Then, if actual times are kept, and actual quantities of materials used are shown on the various jobs that go through, the comparisons of these times and quantities will show what is going on; and it is said to be unnecessary to convert these figures into money and put them on the books of account. There is obvious reason in this point of view; one can well imagine cases where it would be the desirable thing.

In other cases it is thought to be unnecessary to keep detailed records of the actual labor time and actual amount of materials put into individual jobs. In other words, advantage is taken of the standard costs to eliminate much of the detailed work. Then the comparisons are made between total figures, say, for the

month, in order to get the differences which arise between actual costs and standard costs. In such a case, therefore, the standard quantity figures are converted into money, but in totals only, and there is no detailed record of the actual costs.

The preferable method, as already indicated, would have to depend on the circumstances of the case and the kind of information which it was important to get. If the workers can be fairly well controlled by personal supervision, without observation of individual records, it is sufficient to show comparisons between the standard and actual figures in totals only. But if it is desired to have comparative figures on each job in order to watch how things are going, it might be preferable to have standard and actual figures on each job, in quantities only for materials, and in time only for labor, without computing the corresponding money values to be incorporated on the books.

BIBLIOGRAPHY OF GENERAL COST LITERATURE

A. BIBLIOGRAPHICAL SOURCES

ACCOUNTANTS' INDEX. American Institute of Accountants, 1921, pp. 1,578. A practically complete bibliography of accounting literature to date of publication.

ACCOUNTANTS' LIBRARY. A collection of books published by Gee & Co., London, England. Each volume deals with the accounting for some one industry.

JOURNAL OF ACCOUNTANCY. Issued monthly by The Journal of Accountancy, Inc., New York. Current Literature Section in each issue is practically a continuation of the *Accountants' Index*.

NATIONAL ASSOCIATION OF COST ACCOUNTANTS. Bulletin Service includes a monthly issue on Current Cost Literature. Official publications are a fortnightly series, each one dealing with some specific cost accounting topic.

NATIONAL ASSOCIATION OF COST ACCOUNTANTS. Vol. II, No. 10. A Bibliography of Cost Books.

B. COST ACCOUNTING BOOKS AND ARTICLES

ALLEN, J. "Practical Costing," *Business Organization and Management*, Dec., 1920; Jan., Feb., Apr., and May, 1921.

ARMSTRONG, G. O. *Essentials of Industrial Costing*. D. Appleton & Co., New York, 1921.

ATKINS, PAUL M. "Industrial Cost Accounting for Executives," *American Machinist*. A series of articles beginning Nov. 9, 1922, pp. 727-9, and continuing through 1922 and 1923.

BASSET, WILLIAM R. *Accounting as an Aid to Business Profits*, pp. 210-279, 307-309. A. W. Shaw Co., Chicago, 1918.

BASSET, WILLIAM R. *et alii*, "Sales and Administrative Costs," *N. A. C. A. 1922 Year Book*, pp. 103-154.

BASSET, WILLIAM R. and HEYWOOD, JOHNSON. *Production Engineering and Cost Keeping*. McGraw-Hill Book Co., 1922.

BERNDT, I. A. *Costs—Their Compilation and Use in Management*. H. P. Gould & Co., Chicago.

BIVINS, P. A. "Charting as an Aid in Stabilizing Profits," *Industrial Management*. A series of articles, May to Oct., 1922.

BLAIR, F. R. "Business Forecasting in the Edison Industries," *Administration*, Jan., 1923, pp. 1-8.

BOYD, J. H. H. "Costing in Relation to Scientific Management," *The Canadian Chartered Accountant*, May, 1922, pp. 404-423.

BUNNELL, STERLING H. *Cost-Keeping for Manufacturing Plants*. D. Appleton & Co., New York, 1911.

CALL, H. A. "Accurate Plumbing and Heating Estimates: How Made," *Sanitary and Heating Engineering*. A series of articles beginning Apr. 8, 1921.

CARTER, R. N. *Advanced Accounts*, pp. 566-640, 808-826. Isaac Pitman & Sons, New York, 1920.

CATHLES, A. *The Principles of Costing*. Gee & Co., London, 1922.

CHURCH, A. HAMILTON. *Manufacturing Costs and Accounts*. McGraw-Hill Book Co., New York, 1917.

COLE, WILLIAM MORSE. *Accounts—Their Construction and Interpretation*, pp. 141-151, 270-327. Houghton, Mifflin Co., New York, 1915.

COLE, WILLIAM MORSE. *The Fundamentals of Accounting*, Chs. VI, XXII. Houghton, Mifflin Co., New York, 1921.

COLEMAN, T. E. *The Civil Engineers' Cost Book*, Second Edition. Gee & Co., London, England, 1916.

COOK, CHARLES B. *Factory Management*. Bookkeeper Publishing Co., Detroit, 1906.

COPELAND, MELVIN T. *Business Statistics*, pp. 402-684. Harvard University Press, Cambridge, Mass., 1917.

DANIELS, F. R. "Production Control by Graphics," *Machinery*, Oct., 1921, pp. 112-120.

DAWSON, SIDNEY S. and DEZOUCHE, R. C. *Accounting*, pp. 38-47, 204-233, 248-256. Isaac Pitman & Sons, New York, 1920.

DAY, CLARENCE M. *Accounting Practice*, pp. 89-312. D. Appleton & Co., New York, 1908.

DENHAM, R. S. "Engineering Methods Applied to Cost Finding," *Industrial Management*. A series of articles beginning Feb., 1922, pp. 67-73, and continuing through Sept., 1922.

DICKINSON, ARTHUR LOWES. *Accounting Practice and Procedure*, pp. 190-211. Ronald Press Co., New York, 1918.

DICKSEE, LAWRENCE R. *Auditing—A Practical Manual for Auditors*, 10th Edition, pp. 44, 53-57, 70-189, 208, 215-235, 255-262. Gee & Co., London, England, 1915.

DICKSEE, LAWRENCE R. *Fundamentals of Manufacturing Costs*. Gee & Co., London, England.

DIEMER, HUGO. *Factory Organization and Administration*, pp. 51-58, 142-149, 175-191, 212-224, 269, 292, 292-304. McGraw-Hill Book Co., New York, 1914.

EGGLESTON, DEWITT CARL. "Cost Accounting," *Business Accounting*, Vol. II. Ronald Press Co., New York, 1920.

EGGLESTON, D. C. and ROBINSON, F. B. *Business Costs*. D. Appleton & Co., New York.

ELBOURNE, EDWARD T. *Factory Administration and Accounts*, Third Edition. Longmans, Green & Co., New York, 1921.

EMERSON, HARRINGTON. *The Twelve Principles of Efficiency*, pp. 205-238, 371-397. The Engineering Magazine Co., New York, 1913.

EVANS, H. A. *Cost-Keeping and Scientific Management*. McGraw-Hill Book Co., New York, 1911.

FICKER, NICHOLAS THIEL. "Industrial Cost Finding," *Factory Management Course*, Vol. V. Industrial Extension Institute, New York, 1917.

FRANKLIN, BENJAMIN A. *Cost Reports for Executives.* Engineering Magazine Co., New York, 1913.

GARCKE & FELLS. *Factory Accounts*, 17th Edition. Crosby Lockwood & Son, London, England, 1922.

GARRY, H. S. *Multiple Cost Accounts.* Gee & Co., London, England, 1906.

GARRY, H. S. *Process Cost Accounts.* Gee & Co., London, England, 1908.

GILLETTE, H. P. and DANA, R. T. "Cost Analysis Engineering," *Cyclopedia of Commerce, Accountancy, and Business Administration*, Vol. II. American Technical Society, Chicago, 1918.

GILLETTE, H. P. and DANA, R. T. *Cost-Keeping and Management Engineering*, pp. 64-109, 127-339. McGraw-Hill Book Co., New York, 1916.

GILLETTE, H. P. and DANA, R. T. *Mechanical and Electrical Cost Data.* McGraw-Hill Book Co., New York, 1918.

GILMAN, STEPHEN. *Principles of Accounting*, pp. 346-371. LaSalle Extension University, Chicago, 1916.

HARRISON, G. CHARTER. *Cost Accounting to Aid Production.* The Engineering Magazine Co., New York, 1921.

HARRISON, G. CHARTER. "Working Plans for Standard Costs," *Management Engineering*, June, 1922, pp. 331-6 and later issues.

HARRISON, G. CHARTER. "What Is Wrong with Cost Accounting?" *N. A. C. A. Official Publications*, Vol. II, No. 15.

HATFIELD, HENRY R. *Modern Accounting*, pp. 293-315. D. Appleton & Co., New York, 1909.

HAWKINS, L. WHITTEM. *Cost Accounts—An Explanation of Principles and a Guide to Practice.* Gee & Co., London, England, 1912.

HAZELL, W. HOWARD. *Costing for Manufacturers.* Nesbit & Co., England, 1921.

JONES, EDWARD D. *The Administration of Industrial Enterprises.* Longmans, Green & Co., 1919.

JORDAN, J. P. "Managerial Control Through Costs," *Management Engineering*, Feb., 1923, pp. 81-86, and later issues.

JORDAN, J. P. "Under What Conditions Should Schedule Costs Be Used and How Should They Be Proved?" *N. A. C. A. Year Book*, pp. 45-58.

JORDAN, J. P. and HARRIS, G. L. *Cost Accounting Principles and Practice.* The Ronald Press Co., 1922.

KENT, WILLIAM. *Bookkeeping and Cost Accounting.* John Wiley and Sons, New York, 1918.

KESTER, ROY B. *Accounting—Theory and Practice*, Vol. II, pp. 49-60. Ronald Press Co., New York, 1918.

KIMBALL, DEXTER S. "Cost Finding," *Modern Business Course*, Vol. X, Alexander Hamilton Institute, New York, 1919.

KIMBALL, DEXTER S. *Principles of Industrial Organization*, pp. 110-168, 199-226. McGraw-Hill Book Co., New York, 1913.

KNOEPPEL, C. E. *Graphic Production Control*, pp. 151-155, 363-381, 413-419. The Engineering Magazine Co., New York, 1920.

LISLE, GEORGE. *Encyclopedia of Accounting*, Vol. II, pp. 252-299. Vol. V, pp. 1-5, 199-225, 336-344, 415-466. William Green & Sons, London, England, 1903.

LUNT, H. J. "Cost Accounts and Factory Organization," *Business Organization and Management.* A series of articles, Feb. to Aug., 1920.

LUNT, H. J. *Manual of Cost Accounts.* Isaac Pitman & Sons, New York, 1922.

MATHEWSON, P. "Expense Control Through Budgeting," *Industrial Management.* A series of articles Oct., 1922, to Jan., 1923.

MCCHESNEY, L. W. "Business Forecasting in the Edison Industries," *Administration*, Feb., 1923, pp. 171-6.

MCKINSEY, J. O. *Budgetary Control.* Ronald Press Co., New York, 1922.

MILLER, H. F. "Business Forecasting in the Edison Industries," *Administration*, Nov., 1922, pp. 553-558.

MONTGOMERY, ROBERT H. *Auditing Theory and Practice,* Third Edition, Vol. I, pp. 117-172, 621-654, Vol. II, pp. 110-217, 502-518. Ronald Press Co., New York, 1922.

MOXEY, EDWARD P. *Principles of Factory Cost-Keeping.* Ronald Press Co., New York, 1918.

NEWMAN, E. W. *Theory and Practice of Costing.* Isaac Pitman & Sons, New York, 1921.

NICHOLSON, J. LEE and ROHRBACH, JOHN F. D. *Cost Accounting.* Ronald Press Co., New York, 1919.

NICHOLSON, J. LEE. *Cost Accounting—Theory and Practice.* Ronald Press Co., New York, 1913.

NICHOLSON, J. LEE. *Factory Organization and Costs.* Kohl Technical Publishing Co., New York, 1909.

PHILIPS, E. H. and BALDWIN, G. S. "Business Forecasting in the Edison Industries," *Administration,* Dec., 1922, pp. 671-9.

PIXLEY, FRANCIS W. *The Accountant's Dictionary.* Isaac Pitman & Sons, New York.

RIDGWAY, A. CLIFFORD. *Cost Accounts in Principle and Practice.* Isaac Pitman & Sons, New York, 1922.

SALIERS, EARL A. *Accounts in Theory and Practice; Principles,* pp. 251-280. McGraw-Hill Book Co., New York, 1920.

SCOVELL, CLINTON H. *Cost Accounting and Burden Application.* D. Appleton & Co., New York, 1920.

STRACHAN, W. *Cost Accounts: The Key to Economy in Manufacture,* Fourth Edition. Sweet & Maxwell, London, England, 1921.

THOMPSON, C. B. *The Taylor System of Scientific Management.* A. W. Shaw Co., Chicago, 1917.

WALTON, S. and GILMAN, STEPHEN. *Auditing and Cost Accounts,* pp. 219-254. Alexander Hamilton Institute, New York, 1913.

WEBNER, FRANK E. *Factory Accounting.* LaSalle Extension University, 1917.

WEBNER, FRANK E. *Factory Costs.* Ronald Press Co., New York, 1911.

WILDMAN, JOHN R. *Cost Accounting.* The Accountancy Publishing Co., New York, 1911.

WILDMAN, JOHN R. *Principles of Cost Accounting.* New York University Press, New York, 1920.

WOODS, CLINTON E. *Industrial Accounting Methods for Industrials,* 1917.

WOODS, CLINTON E. *Manufacturing Cost.* The Business Man's Publishing Co., Detroit, 1904.

WOODS, CLINTON E. *Practical Cost Accounting for Accountant Students.* 2 Vol., Universal Business Institute, New York, 1908.

——— "Accounting for By-Products," *N. A. C. A. Official Publications,* Vol. I, No. 7.

——— "Methods—Equipment Rental, Quantity Survey, Estimating." *The Bulletin of the Associated General Contractors,* Feb., 1921, pp. 42-43.

——— "Standardizing of Costs," *The Cost Accountant,* Jan., 1923, pp. 146-150.

——— "The Necessity for Scientific Costing," *The Cost Accountant,* Mar., 1922, pp. 178-193.

——— "The Cost System and Its Relation to Production," *Engineering Production,* London, Jan. 5, 1922, pp. 7-10; Jan. 12, 1922, pp. 31-34.

——— "Centralized and Decentralized Cost Accounting and Control," *N. A. C. A. Bulletin No. 14,* Nov. 1, 1921, pp. 66-70.

PROBLEMS IN INDUSTRIAL ACCOUNTING

PART II

PROBLEMS

PREFACE TO PART II

THERE is a great variety of form in the problems presented here. In some cases the situation only is described, and the reader is left to work out the accounting solution. In other cases, the present accounting practice is described in some detail, for the reader to comment upon it in any way he thinks fit. In still other instances, an accounting procedure which is the result of many years of trial and adaptation is presented as an example of accounting practice which may be regarded as satisfactory.

There has been considerable discussion as to whether the term "problems" or the term "cases" is more suitable to cover material of this kind. From the above, it will be seen that examples of both are contained in this volume. Some of them are problems calling for solution. Others are cases of business situations for which a solution was found and is presented for critical examination. Some of the problems have questions appended to them directing attention to important issues. In others the reader is left to discover for himself what the problems are. In actual practice, the formulation of the problem is frequently more difficult than finding an answer to it when formulated.

The problems containing detailed descriptive matter will be found to supplement the brief statement of principles contained in Part I. A study of some of these cases relating to the main cost elements—Material, Labor, and Burden—will be necessary to make the treatment of those subjects clear. It is believed that there is sufficient descriptive material contained in some of them to suffice for that purpose.

With regard to the considerable collection of problems in Chapter VI, descriptive of conditions in various industries, it is again suggested that too much time should not be spent in trying to work out detailed procedure.

I

INTRODUCTION: PRODUCTION ORDERS: COST LEDGERS

1. BRETTLE LANE CEMENT COMPANY—GENERAL AND COST LEDGER ACCOUNTS

THE Brettle Lane Cement Company owns the land and buildings in which its operations are conducted, together with an adjacent quarry from which one of its principal raw materials—limestone—is obtained. The other principal ingredient—blast furnace slag—is purchased from neighboring iron works, and is delivered to the cement mill by rail, at a price f.o.b. shipper's works.

The quarry is equipped with drills, blasting materials, steam shovels, and light railways for hauling the rock. There is also located in the quarry a crusher which effects a preliminary breaking up of the rock. Some of the larger materials produced by this plant are sold for road material, the finer sizes being carried to the cement mill. There is some manufacturing advantage in this elimination of larger sizes from the cement material, as the remainder requires much less grinding in the mill.

Blast furnace slag contains the other essential materials for cement; namely, silica, alumina, and iron oxide. Portland cement is a chemical compound of lime, silica, and alumina. The proportion of these various elements present in the mix, and of such impurities as iron, sulphur, and alkalies, has a great influence upon the temperature required in the burning. The Brettle Lane Company, therefore, makes frequent analyses in its laboratory and conducts many experiments aimed at a proper calculation and control of the mixture.

The works equipment consists essentially of a crusher, a drier, and a mill to handle the limestone, and a separate similar set to grind the slag. The two materials then come together in a mixer; the mixture is finely pulverized in another mill, from which the powder is fed into a kiln and there burnt. There are four kilns

at this plant, all equipped with the necessary elevator, platform, and feeder. A coal mill grinds the coal which is to serve as fuel; the coal is very finely powdered and blown into the lower end of the kiln, where it is fired to produce a most intense heat. The materials fuse into small balls of cement, called "clinkers," which are run successively into two other large cylinders, for cooling purposes. An air current from the first of these cylinders, greatly heated by the clinkers just come from the burning, passes back into the kiln, and there aids the economical combustion of the coal dust.

The crushing of the coal, pulverizing it and feeding it to the kiln, is one of the most important and exacting of all the processes. The care with which it is done has considerable effect upon the temperature obtained in the kiln, and therefore upon the quality of the product and the economy of its production. It is estimated that the costs of this operation amount to from 5 to 10 cents per barrel of cement; but this high cost is in part offset by the fact that a careful pulverizing of poor coal will give better results than a coarser treatment of more high-priced coal. Precautions against fire and explosion are also necessary in the handling of the coal mill.

The clinkers which emerge from the coolers, though small, are harder than the raw materials from which they are made. They have to be ground to a fine powder, and the equipment for grinding clinkers is almost the same as that for grinding raw materials. There are three stages in the grinding, performed by three different mills, each having its necessary attachments of conveyors and elevators. Gypsum is added at this point to control the set. From the final grinding the cement passes to the storage bins.

A cement mill requires very large storage capacity, for two reasons: (1) the quality is somewhat improved by proper storage for a considerable period, and (2) the main selling period occupies only the four months of July, August, September, and October, during which 50% of the product is shipped. The Brettle Lane Company, like nearly all other cement manufacturing companies, runs its mill all the year round, though not always at full capacity, and its storage bins have a capacity of just over 5,000,000 cubic feet. It is usual to supply customers with samples or with test analyses of the cement in storage.

The market price of cement is quoted on the basis of a barrel of 376 lbs. net. The cement is actually put up by the Brettle Lane Company in 94-lb. sacks, giving four sacks to the barrel. Customers are charged extra for these sacks and allowed the same amount as rebate upon returning them to the mill.

The company obtains its power by developing steam in boilers heated by coal, the power being transmitted to various parts of the plant by the usual system of pipes, shafting, and pulleys.

Assuming that a general ledger and a cost ledger are to be kept by the Brettle Lane Cement Company, draw up a list of the accounts which you would recommend for each ledger, arranged in a classified order to show the relations between them. The company wishes to show departmental costs and deems the several items of expense within each department to be of sufficient importance to be shown separately.

Describe precisely how the general ledger control of the cost ledger will be exercised.

Is the cost ledger which you propose subordinate to, or coordinate with, the general ledger?

2. BIGELOW COFFEE COMPANY—CONTROL OF SUBSIDIARY BAG FACTORY

The Bigelow Coffee Company runs a factory in which it manufactures large quantities of cloth and paper bags, printed with its name and trade-mark design. The bag factory is treated as a separate manufacturing unit, with its own set of accounts, controlled from the general ledger. Completed bags are turned over to the coffee department at the same prices as those at which the coffee department buys similar bags in the market.

The bag factory general ledger balance sheet is as follows on January 1, 1921:

ASSETS

Raw Materials	$ 6,000
Goods in Process—General	5,000
Goods in Process—Printing	900
Printing Plates	800
Machinery and Equipment	40,000
	$52,700

LIABILITIES

Accrued Liabilities	$ 1,500
Allowance for Maintenance *	300
Allowance for Depreciation	3,400
General Ledger—Current Investment †	10,400
General Ledger—Profit and Loss ‡	.....
General Ledger—Liabilities **	.....
General Ledger—Fixed Investment ††	37,100
	$52,700

* An account credited when a fixed charge is made monthly to operating; actual expenditures are charged to the allowance account.
† The control of investments in the bag factory's current assets.
‡ Control of profit and loss—transferred annually to the Current Investment Control.
** Current expenditures of the central office on behalf of the bag factory are credited to this account; sales from the bag factory to the coffee department are debited here; the balance at the end of the year is transferred to the Current Investment Control.
†† The control of investment in the bag factory's fixed assets.
Accounts marked †, ‡, **, and †† are in the contra accounts to four similar accounts in the general ledger, which, in combination, form the general ledger control of the bag factory ledger.

During 1921 the central office, by means of debit memoranda, charges disbursements for the following amounts to the bag factory: Raw materials, $28,000; Printing Plates, $400; Maintenance, $750; Labor—Direct, $30,000; Supervision, $4,000; Rent, $1,200; Interest, Insurance and Taxes, $1,600; Storage Costs, $900; Power, $1,400; Labor—Indirect, $3,000; Unloading, $2,000; Burlap and Twine, $300; Supplies, $400.

The accrued liabilities were also paid by the central office.

It is the custom to charge operations with one-fourth of the balance in Printing Plates account at the end of the period, on the ground that they last four years upon the average.

Provision for depreciation is determined to be $800; and provision for maintenance, $950.

Insurance and Taxes accrued at the end of the period, $400.

The overhead expenses are allocated, $6,740 to Printing Overhead, and $10,510 to General Overhead.

Of the direct labor, $12,000 is charged to the printing department, and $18,000 to the general manufacturing account. On these amounts, the respective prorated overhead charged to the product totals $6,200 and $9,700.

Raw materials requisitioned, chargeable to the general manufacturing account, $26,000.

Printed stock transferred to general manufacturing, $18,500.

Sales for the period, $74,800; cost of goods sold, $69,700.

Record the transactions on a working sheet, carrying the balances forward to their ultimate destinations, and show the balance sheet of the bag factory at the end of the period.

Give a statement explaining precisely what has occasioned the change in the Current Investment Control Account.

What are the merits of the form of control illustrated in this problem?

3. LEIGHTON MILLS—TYING IN COST ACCOUNTING WITH THE GENERAL BOOKS

The treasurer of the Leighton Mills was considering the advisability of combining the cost accounting system and the general books of the company.

For cost accounting purposes the mill was divided into six departments:

1. Picking and Carding
2. Spinning
3. Spooling and Warping
4. Dressing and Drawing in
5. Weaving
6. Cloth Room

The various items of overhead were distributed to these departments on the following bases:

General Overhead Accounts	Bases of Distribution
General Expenses and Administration	Payroll
Interest, Taxes, Insurance, Depreciation	Value and Space Occupied and Value of Equipment
Power	Power Used
Repairs	Space Occupied, Direct, and Power
Supplies	Direct

In determining the cost of any style of cloth, the piece-rate per pound of product in each department was ascertained. To this was added a standard percentage for indirect labor determined from past operations. A standard percentage also was applied to total labor cost per pound for overhead in that department. The total of these costs for the six departments indicated the cost per pound of the cloth delivered to the selling agents. Raw material costs were secured by averaging the price paid for the cotton and dividing this amount by a percentage, commonly 85%, which made the allowance for waste.

The cost of the cloth per yard was determined by dividing the total cost per pound by the number of yards per pound.

The treasurer's office received the following reports from the mill:

1. *Weekly Picking and Carding Report.* Production of each number of roving compared with the standard production for the number of drawing frames scheduled during the week.

2. *Weekly Spinning and Spooling Report.* Production of each kind of yarn compared with the standard production for the number of spinning frames scheduled on that number.

3. *Weekly Loom and Production Reports.* Loom production for each style in yards of cloth as compared with the standard production for the number of looms scheduled on that style.

4. *Weekly Memorandum of Shipments of Finished Product.* Shipments of bales, weight, and destination.

5. *Weekly Supplies Used.* Record made out in the storeroom of the departments in the mill to be charged with the supplies used during the week.

6. *Weekly Payroll Summary.* Total payroll, direct labor, indirect labor, and the ratio of direct and indirect labor for each department.

In the treasurer's office the cash expenditures were distributed to the following main ledger accounts:

1. Cotton
2. Mill Labor
3. General Expense
4. Power
5. Mill Supplies
6. Administration
7. Interest
8. Taxes
9. Insurance
10. Repairs and Maintenance
11. Selling Expenses

These accounts were closed quarterly into a Total Manufacturing Account, which was closed into a Cloth Account, to which sales were credited. The balance of this account went to Profit and Loss, which was debited with provision for depreciation and taxes. The balance of Profit and Loss went to Surplus, out of which dividends were paid.

The accountant was opposed to changing the system for one that provided for the tying in of cost figures with the general accounts. He believed that a quarterly reconciliation was sufficient to determine the accuracy of the cost system. To combine the general accounts with the cost system would, in his opinion, complicate both without compensating advantages, and necessi-

tate the employment of a larger clerical force. He admitted, however, that few changes would be necessary to combine the systems, and that more accurate accounting would be made possible during the period between financial reports.

Should the cost accounting system of the Leighton Mills have been combined with the general accounting system in use?

4. MERROW PAPER COMPANY—COST AND GENERAL ACCOUNTS

The board of directors of the Merrow Paper Company believed it necessary, for the proper executive control of the company, to have the cost accounting figures of their producing plants

MERROW PAPER COMPANY—Cost of Sales Analysis

Account	Mill Number 1	Mill Number 2
Raw Material	$1,408,750.50	$ 630,840.00
Labor	1,200,825.00	582,500.00
Wires	70,600.00	32,320.00
Packing Cases	152,035.00	68,830.00
Steam	300,605.00	144,110.00
Power	108,118.00	45,970.00
Light	80,001.00	37,115.00
Depreciation, Insurance, Taxes	148,000.00	68,120.00
Repairs	72,500.00	32,840.00
Miscellaneous Supplies	100,000.00	47,000.00
General Mill Expense	9,975.00	2,700.00
	$3,651,409.50	$1,692,345.00
Increase in Inventory	184,390.00	86,798.00
Overdistributed Machine Expense Deducted	* 8,612.00	* 6,298.00
Adjustments	73,233.00	19,695.00
	$3,900,420.50	$1,792,540.00
Cost of Sales (Mills Numbers 1 and 2)	$5,692,960.50	

* Deducted from expense at close of accounting period.

shown clearly in relation to the final income and balance sheets of each accounting period.

The Merrow Paper Company sold high-grade office stationery. The sales organization was located in Boston and production was carried on at two mills situated at different points in New Eng-

MERROW PAPER COMPANY—Income Sheet

Gross Sales		$7,211,868.00
Less		
Credits	$ 70,280.00	
Freight	300,128.00	
Discounts	210,900.00	
	$581,308.00	581,308.00
Net Sales		$6,630,560.00
Less		
Cost of Sales		5,692,960.50
Gross Profit on Sales		$ 937,599.50
Less Administration Expense		200,399.50
		$ 737,200.00
Less Distribution Expense		293,400.00
Net Profit on Sales		$ 443,800.00
Add Other Income		20,812.50
		$ 464,612.50
Deduct Other Charges		
Interest Payable		131,326.11
Earnings for 1922		$ 333,286.39

land. The Boston office audited the books of both mills and also kept the general books of the company.

The desired relationship of the cost accounting figures to the final statement as taken from the company's general ledger was made clear by submitting, in addition to the usual balance and income sheets, a third statement entitled "Cost of Sales Analysis." The results of the company's business during the year 1922 were shown in the three statements named, copies of which are presented herewith.

What additional information would it be desirable for the directors to have, in order to increase the usefulness of the reports shown? Would such information be easily available?

MERROW PAPER COMPANY—Balance Sheet, December 31, 1922

ASSETS

Current Assets	$ 3,900,250.18
Investments	180,473.05
Plant and Equipment	6,800,825.00
Suspense Charges	100,240.36
Good-Will	275,000.00
	$11,256,788.59

LIABILITIES

Current Liabilities			$ 1,685,000.00
Miscellaneous Liabilities			678,002.20
Capital Stock			7,500,500.00
Surplus			
December 31, 1921	$1,367,000.00		
Earnings, 1922	333,286.39		
		$1,700,286.39	
Dividends Payable	$185,000.00		
Taxes and Allowances	122,000.00		
		307,000.00	
			1,393,286.39
			$11,256,788.59

5. THE ACKWORTH COMPANY—PRODUCTION ORDER PROCEDURE

The Ackworth Company has experienced a lack of coordination between its various departments, which has resulted in failure to control work in process. A planning department has, therefore, been established in order to supervise and direct the operations performed in the plant. The company makes a variety of iron and steel products, some of them being single pieces, others an assembly of parts.

A balance-of-stores record, or perpetual inventory of manufactured parts, gives the quantity of each part ordered to be manufactured, the amount on hand, the amount apportioned or set aside for specific orders, and the balance available. A minimum limit is determined below which the number of parts avail-

able will not be allowed to fall before the planning department is notified that a production order is needed. This basic minimum is determined by the normal rate of the product used during the time required for a new lot to be manufactured, plus a margin of safety to take care of delays and other emergencies. As soon as the quantity of a product available approaches the minimum, a notice of minimum is sent to the planning department by the balance-of-stores clerk. The quantity which shall be called for in each production order is determined on the basis of careful calculations in which the monthly sales of the past year, the estimated monthly sales of the coming period, and the most economical run are included.

In order to give the different departments of the plant due notice of the work which is scheduled, so that they may be prepared to handle it, the order clerk in the planning department sends a production order to each department for each job upon which it is to do any work. This production order is sent out several days in advance of the time the work is to be done, but gives no authority to begin manufacturing.

When one job has been finished, the manufacturing department returns the time slips for the individual workmen to the order clerk of the planning department who issued the time slips for the next job. These time slips, which give the authority to begin work, are issued in duplicate; the original is given to the foreman and the duplicate is carried by the man working on the order. The original job time card is about 3¼ by 7¼ inches and is used later in tabulating the payroll and labor cost information on the Hollerith Tabulating Machines. This card covers the order and item numbers, the number of the machine to be used, the number of the operation, the quantity, size, and description of the product to be made, the time the work was started and the time it was finished, the quantity completed, the piece or hourly rate, and the amount due the workman. The same form is used for indirect labor. On the back of the duplicate the foreman or inspector records information as to the workman's production, and the quantity spoiled, in pieces and pounds. When the work has been completed and the time card has been returned to the planning department, the order clerk is able to determine the progress of the work through the plant, and the quantity remaining to be completed on that order.

The original time cards are then punched preparatory to running them through the Hollerith Tabulating Machines to ascertain the total payroll for each department and the total amount due each man. The departmental payrolls are then checked against the total payroll figures for the individual men. The direct labor cards are then sorted from the indirect labor cards so that the direct labor may be charged to the jobs on which it was incurred, and the indirect labor may be charged to the proper overhead accounts. For ease in filing, all production orders, duplicate time slips, and notices of minimum are the same size as the original Hollerith Machine time card.

Draft forms for notices of minimum, production orders, and time cards.

6. FAIRMOUNT MANUFACTURING CORPORATION— HANDLING OF "STOCK" ORDERS

The Fairmount Manufacturing Corporation was formed in the fall of 1917 to take advantage of the war demand for small motors. After a six months' period of operation, it was found advisable to change the system by which costs were obtained. Outside advice was desirable, and for this purpose, a New York firm of accountants was asked to send a representative to check over the company's methods and recommend such changes as should appear to him to be advisable.

It had been found by the company that when an attempt was made to keep separate costs upon small articles needed for stock which were ordered at frequent intervals, the result was that the commodities applying on these orders were so intermingled with the consequent confusion in labor and materials that it was impossible to obtain costs separately with any degree of accuracy. In order to remedy this defect, the following procedure was recommended by the New York auditor.

A. Definition

1. The term "Stock Orders" means such commodities that are manufactured for stock purposes, and not for any particular Sales Order. The class of commodity that falls under this classification is as follows:

Valves Nuts Washers Small parts Rivets Bolts Flanges

2. The point to be distinctively understood in designating a "stock order" is that the commodity to be manufactured is not to be used for

a special order, and that it is the purpose of the management to carry a stock of such an article.

3. If it is the intention of the management merely to produce a quantity of any article, or combination of articles to satisfy one, or a number of orders, then it is not the purpose that a stock order be used, but instead a standard manufacturing order should be issued in each instance; and where it is considered impossible to keep costs separately for each order, owing to the operation for more than one order being performed simultaneously, then a combination order should be issued covering the particular orders in question, and the consolidated cost contained upon this particular order should be divided pro rata among the orders covered thereby.

4. The main purpose of a stock series of orders is to accommodate the requirement which necessitates frequent ordering of material of the same kind, with the consequent impossibility of segregating the cost during the process to the various orders.

5. For this reason, it has been deemed best, where material of a kind is being frequently ordered, that one stock order number should exist for such an article—all costs being recorded under the one number, and the unit cost of each article being determined monthly as the total costs of all items and operation entering into that article, divided by the number of finished articles of that commodity produced during that cost period. Where what is considered stock commodities are produced, at longer intervals than cited in the foregoing, it is permissible to issue a separate order in each instance.

B. Issuing Orders to Replenish Stock of Stock Parts

1. The various storekeepers who are responsible for maintaining stock of the respective stock material coming under their jurisdiction are also responsible for the issuing of requisitions to replenish their stock when necessary. These requisitions should state the quantity required, description, standard manufacturing order number, and a requisition number. This requisition should be forwarded to the Accounting Department which will then issue its stock order to the respective departments. The required number of copies should be given to the department, or departments, which will manufacture.

C. Method of Determining Unit Cost of Stock Orders

1. The difficulty involved in determining costs of this character is that unless condemnations are reported at the various stages where they occur, the proper credit by material or item or operation will not be given to each order number with a consequence that the absolute unit cost is not obtained. It is not considered necessary that the condemnations be obtained by operations; but, if possible, the condemnations should be obtained by article, or part (according as the cost is kept), and that monthly, if possible, credit be given to the particular order number, and the scrap account charged at the scrap value of such condemnation.

2. Since it is recognized that condemnations occur in practically all items of stock manufacture, and that they occur during the various stages of manufacture, thus requiring a greater number to be ordered than is actually completed, proper care must be exercised to obtain the total number of good pieces, or parts, produced under each operation, or cost of material, which, divided into the figures representing such labor, expense, or material, will supply the unit cost under each element of the cost, the aggregate of which unit costs represents the unit cost of such article or part. This unit value times the parts completed during that cost period, should be the value of completed parts transferred into the Inventory account. The remainder value appearing upon each order should represent the cost of uncompleted parts in process.

D. Accounting Procedure for Rivets and Bolts

1. Cost should be prepared according to the diameter only (up to ½ inch and over ½ inch), and the product shall be expressed in weight. Special Inventory accounts should be prepared for each size (diameter), and monthly cost sheets should be the means for the preparing of the Journal Voucher, both for consumption and production. Labor is now being reported according to diameter, and is consequently easily accumulated to each of the products. Operating expenses should be distributed to each size, upon the best basis determinable, which is believed to be the labor basis. Under this arrangement, an Inventory account is provided for each size, which inventory account will be accumulated both by weights and values, received and disbursed, and will be the means from which the Material Division will obtain its monthly average price for consumption during the subsequent month. Scrap credit should be assigned to each size, upon the basis of weight charged, and should be shown upon the respective cost sheet.

7. The Murdock Sash and Door Company—Summarizing Costs

I. Schedule of Fixed Investment

Department	Land	Brick Buildings	Wood Buildings	Machinery and Equipment	Horses and Wagons	Total for Department
Lumber Yard	$20,000		$10,000	$ 1,200		$ 31,200
Kilns	1,100	$ 7,500		4,000		12,600
Power House	1,800	4,500		17,000		23,300
Cutting Dept.	1,900		7,000	12,000		20,900
Molding Dept.	1,400		8,000	13,000		22,400
Door Dept.	1,100		6,000	11,000		18,100
Sash Dept.	1,200		8,000	10,000		19,200
Glazing Dept.	600		2,000	800		3,400
Warehouse	3,000		9,000	1,000		13,000
General Mfg.	1,000		3,000			4,000
Stables	300		1,000		$1,800	3,100
Office	1,000		3,000	4,000		8,000
	$34,400	$12,000	$57,000	$74,000	$1,800	$179,200

II. Trial Balance, January 1

Land and Buildings	$103,400	
Machinery and Equipment	74,000	
Horses and Wagons	1,800	
Lumber Inventory	34,000	
Other Materials	12,000	
Work in Process	10,000	
Finished Work	15,000	
Supplies	4,000	
Accounts Receivable	18,000	
Cash	6,000	
Accounts Payable		$ 13,000
Mortgage Bonds		35,000
Capital Stock		200,000
Surplus		30,200
	$278,200	$278,200

III. Accounts in General Ledger in Addition to Those in Trial Balance

Property Taxes	Machinery Repairs and Maintenance
Fire Insurance	General Office Expense
Workmen's Liability Insurance	Interest on Bonds
Depreciation	General Manufacturing Expense
Reserve for Depreciation	Profit and Loss
Payroll	Liability Insurance Accrued
Salaries of Superintendence	Interest Payable Accrued
Salaries, Commercial and Administrative	
Building Repairs	

IV. Cost Ledger Balances, January 1

Lumber in Process	$ 3,000
Other Direct Materials in Process	1,000
Cutting Dept. Labor in Process	600
Cutting Dept. Burden in Process	400
Molding Dept. Labor in Process	300
Molding Dept. Burden in Process	300
Power House	400
Door Dept. Labor in Process	900
Door Dept. Burden in Process	800
Sash Dept. Labor in Process	700
Sash Dept. Burden in Process	500
Glazing Dept. Labor in Process	600
Glazing Dept. Burden in Process	400
Stables	100
Total	$10,000

V. Cash Book Totals for January

Received: on Accounts Receivable	$68,000
Disbursed:	
Payroll	16,000
Expenses	14,000
Accounts Payable	28,000

VI. Analysis of Cash Disbursements for Expenses

Property Taxes	$ 600
Fire Insurance	800
Salaries of Superintendence	3,400
Salaries, Commercial and Administrative	4,300
Building Repairs	1,200
Machinery Repairs	1,600
General Office Expense	1,100
General Manufacturing Expense	1,000
Total	$14,000

VII. Purchase Record

Lumber	$19,000
Other Materials	5,000
Supplies	5,000
New Equipment	1,000
	$30,000

VIII. Materials and Supplies Issued to Departments

Account	Lumber	Other Materials	Supplies
To Lumber in Process	$21,000		
To Other Direct Materials in Process		$7,000	
To Kiln Costs			$ 600
To Cutting Dept. Work in Process			500
To Molding Dept. Work in Process			900
To Door Dept. Work in Process			1,100
To Sash Dept. Work in Process			900
To Glazing Dept. Work in Process			800
To Power Costs			1,000
To Stables Costs			700
	$21,000	$7,000	$6,500
Inventory of Supplies, end of period, Stables			$100
Power House			300

IX. Distribution of Payroll

Department	Indirect	Direct
Yard	$1,300	
Kilns	400	
Stables	200	
Warehouse	300	
Power-house	300	
General Factory	700	
Cutting	800	$ 1,600
Molding	600	1,800
Door	700	3,200
Sash	300	2,300
Glazing	400	1,100
	$6,000	$10,000

X. Factors in Burden Assembly

Depreciation: 5% per annum on Brick Buildings. 10% per annum on Wood Buildings, Equipment, Horses and Wagons.

Taxes: $30 per $1,000 on all Fixed Investment Assets.

Fire Insurance: $20 per $1,000 on Fixed Investment Assets.

Liability Insurance: 1% of Factory Payroll.

The monthly figure of $3,400 for Superintendence is normal. Normal annual expenditure for Building Repairs is $18,000, and for Machinery Repairs, $24,000. The normal monthly distribution of these items over the departments is as follows:

Department	Superintendence	Building Repairs	Machinery Repairs
Warehouse	$ 100	$ 100	
Stables	100	50	
Power House	400	100	$ 400
Kilns	200	150	
Yard	500	200	100
General Manufacturing	900	150	
Cutting	300	200	450
Molding	200	150	350
Door	300	150	400
Sash	200	150	200
Glazing	200	100	100
	$3,400	$1,500	$2,000

Interest on Bonds is at the rate of 6% per annum, distributed through General Office Expense.

XI. Power Consumption

Of the total Power-House expenses, it is computed that the following percentages should be charged to the departments for heat, light, and power, respectively. A charge to General Manufacturing Expense for the heat and light of the whole factory is deemed sufficient.

Department	Heat	Light	Power
Offices	3.0%	5.0%	
General Manufacturing	3.0	5.0	
Kilns	6.0		
Warehouse			3.0%
Yard			10.0
Cutting			18.0
Molding			16.0
Door			17.0
Sash			9.0
Glazing			5.0
	12.0%	10.0%	78.0%

XII. Distribution of Indirect Departments

A "vicious circle" is met with in transferring the balances of indirect departments, seeing that a part of "Office and Commercial Expenses" are to be charged to "Power House," and a part of "Power House" expenses are chargeable to the Office. For practical purposes, however, the following order of closing has been found satisfactory:

1. Power House Costs distributed on power, light, and heat consumption; see Table XI.
2. Warehouse burden is added to Office and Commercial.
3. General Manufacturing Expenses distributed as a percentage on total productive departmental expense.
4. Stable Expenses added to Yard Expense.
5. Office Burden distributed as percentage of yard, kiln and manufacturing department costs.
6. Yard Expenses added to Lumber Costs.
7. Kiln Expenses added to Lumber Costs.

XIII. Sales Book—Total Figures for Sales, Cost of Sales, and Profits

The Sales Book shows the following total figures for Sales, Cost of Sales, and Profits:

Sales		$82,395.00
Transfers to Finished Goods:		
Lumber in Process	$22,000.00	
Other Direct Material in Process	6,000.00	
Cutting Dept. Labor in Process	1,800.00	
Cutting Dept. Burden in Process	4,905.10	
Molding Dept. Labor in Process	1,900.00	
Molding Dept. Burden in Process	4,702.20	
Door Dept. Labor in Process	3,250.00	
Door Dept. Burden in Process	5,407.00	
Sash Dept. Labor in Process	2,400.50	
Sash Dept. Burden in Process	3,741.05	
Glazing Dept. Labor in Process	1,050.00	
Glazing Dept. Burden in Process	3,010.90	
	$60,166.75	
Cost of Finished Goods Sold		61,166.00
Profit		$21,229.00

XIV. Actual Costs Accumulated on the Job Cost Sheets

The Job Cost Sheets in process were called in from the shop at the end of the month, and the actual costs accumulated on them to date were found to be as follows:

Lumber in Process	$2,000.00
Other Direct Material in Process	2,000.00
Cutting Dept. Labor in Process	400.00
Cutting Dept. Burden in Process	250.00
Molding Dept. Labor in Process	200.00
Molding Dept. Burden in Process	150.00
Door Dept. Labor in Process	850.00
Door Dept. Burden in Process	600.00
Sash Dept. Labor in Process	599.50
Sash Dept. Burden in Process	300.00
Glazing Dept. Labor in Process	650.00
Glazing Dept. Burden in Process	400.00

Prepare a sheet showing a Departmental Distribution of Burden, and show the distribution of expenses called for in the preceding tables.

Post the information given to the General Ledger and to the Cost Ledger, and take a trial balance of each.

What adjustments of the Cost Ledger are called for by the figures of Table XIV? Do you think any need for revision of the accounting methods is indicated there?

REFERENCES

ARMSTRONG, G. S. *Essentials of Industrial Costing*, pp. 259-263.
BOSHER, LEWIS H. "Controlling Accounts in Cost Accounting," *Journal of Accountancy*, June, 1912, pp. 405-419.
CHURCH, A. H. *Manufacturing Costs and Accounts*, pp. 242-271.
EMERSON, H. *Twelve Principles of Efficiency*, pp. 319-338.
JORDAN, J. P. and HARRIS, G. L. *Cost Accounting, Principles and Practice*, pp. 38-63, 71-95.
MEINHARDT, HAROLD S. "Accounting for a Portland Cement Mill," *Journal of Accountancy*, Sept., 1922, pp. 190-197.
NICHOLSON, J. LEE and ROHRBACH, JOHN F. D. *Cost Accounting*, pp. 48-61.
THOMPSON, C. B. *How to Find Factory Costs*, pp. 102-109.
——— "The Outstanding Features of Dennison Management, III," *Industrial Management*, Oct., 1922, pp. 225-230.

II

MATERIALS—HANDLING AND RECORDING

A. ROUTINE PROCEDURE

1. WARNER RUBBER COMPANY—ACCOUNTING FOR MATERIAL

THE Warner Rubber Company consumes annually over $10,000,000 worth of materials in the manufacture of rubber footwear; the method by which these materials are charged into process is therefore important. These materials are valued as follows:

Rubber	$ 3,550,000
Reclaimed Rubber	300,000
Chemical Compounds	950,000
Dry Goods	4,320,000
Shooks, Cartons, and Boards	420,000
Findings	480,000
Miscellaneous	20,000
Total	$10,040,000

All materials are ordered by the purchasing department upon receipt of a notification from the balance-of-stores clerk that the minimum quantity has been reached. This minimum quantity is determined by the purchasing department on the basis of the quantity usually consumed during the time required to receive the material after the order has been placed, plus an allowance to take care of unforeseen delays and other emergencies. The immediate future requirements usually determine the quantity to be ordered at one time, although when a favorable market exists larger orders may be placed. When an exceptionally favorable price can be obtained, orders may be placed before the minimum quantity is reached.

After the materials are checked by the receiving department, they are placed in storage under control of a centralized balance-of-stores system. The balance-of-stores cards give the unit cost, total cost, and quantity of each material placed in storage. The

seven material accounts which are kept in the general ledger are debited with the billed cost and freight; cash discounts which may be taken are closed into Profit and Loss.

Since the cutting department schedules all materials for the make-up of any production ticket, it has charge of the central stores department. Subsidiary storerooms are scattered throughout the factory, but the slips for all materials requisitioned from them are sent to the general stores clerk. The cutting department analyzes each production ticket according to type and style of footwear, in order to calculate the quantity of each material required. Rubber is not compounded or calendered until it is needed by the manufacturing department, and the production ticket is the authority for putting material into process. The balance-of-stores clerk therefore requisitions or ascertains the existence of adequate stocks of all these materials. When these materials are put into process, the quantity issued is recorded on the balance-of-stores cards; Work-in-Process is debited and the material accounts are credited at a standard rate which is the average cost, including freight, which the management estimates it will have to pay during the balance sheet period of six months.

The cost of each style and type of shoe is determined by running test orders through the factory. The standard rates for labor, material, and overhead which are established during the test orders are used in determining costs of finished products. The departmental accounts are debited with actual expenditures and credited with a standard rate when shoes are finished. The balances in the labor and overhead accounts are used as a guide in determining the efficiency of these departments.

At the close of each month an adjustment is made in the material accounts to correct discrepancies which have been caused by a variation in the purchase price from the standard. Inasmuch as the raw material accounts have been credited at the standard cost for materials put into process and have been debited at actual cost, the balances consist of the inventory of materials on hand at actual cost, minus the saving or plus the loss on the purchase of materials compared with the standard. The materials on hand are inventoried at an average cost price determined in the following manner:

Inventory	100,000 pounds @ 18 cents		$18,000
Purchased	10,000 pounds @ 19 cents		1,900
"	50,000 pounds @ 21 cents		10,500
Inward Freight			500
Total	160,000 pounds		$30,900
	Average Cost	19.31 cents per pound	

The difference between the standard rate and the actual cost is transferred monthly to an account called Purchase Variation. When the books are closed for the fiscal period, the balance in Purchase Variation which represents the net saving or loss compared with the standard rate is closed into Profit and Loss. The balances of the raw material accounts then show the amount of raw materials on hand at cost.

Should the Warner Rubber Company use, in charging materials into process, the actual, average, or standard costs?

What forms do you suggest for the recording of materials? Outline rulings for any two of these.

Show the ledger accounts through which materials would pass, giving the debit and credit items in each, and stating from what sources the information for each item is obtained.

2. WARNER RUBBER COMPANY—CONTROL OF MATERIAL IN PROCESS

Production tickets, prepared by the planning department one week in advance, are the authority for putting material in process in the Warner Rubber Company. Since orders for rubber footwear are filled from stock whenever possible, most of the production tickets are standard stock orders. Variation in the demand for sizes and types of footwear, however, causes irregularities in the tickets which make careful scheduling of materials essential. The Warner Rubber Company is interested, therefore, in developing centralized control of material in process.

The rubber, which is received in bales, is cut into slabs and placed in stores. It is put into process by the milling department at a rate determined by guess to keep a minimum stock ready for compounding. The milling process, which requires from 15 minutes to an hour, according to the grade and toughness of the rubber, consists of making the raw rubber soft and pliable. The milled rubber is placed in intermediate stores for a period ranging

from 30 to 45 hours before it is transferred to the compounding room.

When rubber is taken from the intermediate storeroom to be compounded, it is first warmed on a two-roll mill. Reclaimed rubber is mixed with the raw rubber in this process in order to give it the desired degree of toughness. While still warm, the rubber, together with the chemicals, is placed on the compounding calenders. Definite times are set for the running of each batch. An inspector notes the starting time, notifies the worker when the batch should be completed, and inspects the product. The compounded rubber is rolled into chunks weighing about 30 pounds, and placed in another intermediate storeroom where it may remain from one-half to three or four days.

Before it is run on the "upper" or "outsole" calenders, the compounded rubber is warmed in a two-roll calender or milling machine. The "upper" calender presses out thin sheets of rubber which are marked with the outline and size of the binding edge by means of an engraved roller as a guide to the cutters. The engraved rolls are interchangeable so that any number of sizes and styles may be run on one calender. When stock comes from the calender, it is carefully gaged to obtain the proper thickness. Outsoles are marked in the same manner, but the gage is thicker.

Fabrics taken from the materials storeroom are coated on a calender consisting of at least three cylinders, one above the other, all geared to revolve at the same speed. The rubber is inserted between the upper two rolls, and is pressed on to the fabric between the two lower rolls, forming a rubber-lined cloth. Frictioned fabric has the rubber pressed into the cloth itself. The middle roll of a friction calender is geared to run twice as fast as the other two in order to force the warm rubber into the meshes of the cloth. In the case of all frictioned and some coated fabrics, an interlining of plain cloth is used to prevent the freshly coated parts from coming in contact with each other.

Upon being calendered, the rubber stock is cut in lengths of convenient sizes before it is taken to the cutting department. After cutting, the uppers and outsoles are put into a wooden frame with six sheets of cloth sewed on one side in the form of a book. The number of the maker to whom each book is going is marked on the frame before it is taken to an intermediate storeroom.

The fabric, some of which is frictioned and some of which is coated, is cut in 15-foot lengths, and put in piles of from 8 to 40 thicknesses for cutting. A sheet of paper is placed between the lengths to prevent sticking. After the fabric parts are cut, they are placed in a storeroom in the cutting room known as the "post-office," where they are counted, separated from the paper, and put up in sets for the makers according to a production ticket.

From the "post-office" the parts called for on the production ticket are sent to the making department to be manufactured into shoes. Spoiled material is taken back to the calendering department to be worked into a new batch. Spoiled coated fabric, however, becomes waste. The trimming of the shoes, after they have been vulcanized, as well as the waste from the cutting department, is baled and sold. The amount received for this waste material is credited to material in process.

Recently the plant was delayed because of insufficient milled rubber in the intermediate store. As a result, two plans for remedying the situation were suggested. One proposal was that a balance-of-stores card, on which all milled rubber should be recorded when placed in storage and when requisitioned, should be installed in the intermediate storeroom. Another proposal was that the production ticket should be extended to the milling department so that, instead of using it to start operations in the cutting department, all operations should be based on the amount of material required to manufacture the shoes ordered on a production ticket. The only change from the present system would be that the milling department would operate on a ticket four days before the cutting department, the compounding department two days before the cutting department, and the calendering department one day before the cutting department.

What plan of control should the Warner Rubber Company adopt?

3. FOLEY AND JOHNSON—ACCOUNTING FOR MATERIAL

Foley and Johnson has recently grown from a small partnership employing from 10 to 15 men to a firm of construction engineers employing 75 men. This larger scale of operations causes difficulty in keeping track of materials on the various jobs. The two partners opened an office with the intention of organizing

an accounting system which would enable them to maintain an intelligent control of all their building operations; for this purpose they obtained the forms used by the Aberthaw Construction Company [1] of Boston. Since this company works on bigger jobs than those Foley and Johnson are able to handle, they wish to know how much of this accounting procedure is desirable for their small business.

The following method is used by the Aberthaw Company.

1. *General Plan.* All the accounting of the Aberthaw Company is performed on the job. A separate set of records is kept for each job, and with the exception of the head office record of profits on the jobs, there is no book or books in which the records of all jobs are combined. None of the head office charges is loaded on to contract cost, so that no charge is made for the purchase department, bookkeeping department, or professional advice department. All these costs are taken out of the percentage of profit. The head office books are simple, since they show only receipts of profits on various contracts, and disbursements for the head office expenses. This is made possible by the fact that the owner, for whom the work is being done, advances the funds from week to week, out of which the disbursements on the job are made.

When an estimate of a job is completed, it is divided into a material and sub-contract analysis and a labor analysis.

2. *Analysis of Estimate-Material.*[2] The material analysis shows the quantities, unit prices, and total cost of all the material to be used on the job, and the sub-contracts, insurance, and field office equipment—everything in fact except labor. This

[1] See *Journal of the Boston Society of Civil Engineers,* May, 1921, Vol. viii, No. 5, "Construction Costs," by W. N. Connor.

[2] A specimen copy of the material and sub-contract analysis which is furnished to the timekeeper on the job is shown below.

ANALYSIS OF ESTIMATE

Materials and Sub-Contracts

Material	Quantity	Unit Price	Total Cost
Cement	3,400 bbls.	$ 2.29	$7,790
Freight and loss on empties	3,400 bbls.	.05	170
Tests	3,400	.025	85
Sand	3,850 c. y.	2.00	1,700
Gravel	1,500 c. y.	2.50	3,750
Peastone	50 tons	2.50	125
Cinders	220 c. y.	1.50	330

analysis is used for all material cost comparisons and in checking the purchases and prices submitted to the purchasing department.

3. *Purchase Order.* The purchasing department in the head office buys material only upon receipt of a purchasing order from the jobs. This form shows the purpose for which the material is to be used. The form of purchase order used is shown on the next page (Form 9).

4. *Material Received Form.* On receipt of material at the job it is checked by the assistant bookkeeper and entered on

Footnote 2 continued from page 92:

Plant:			
Small tools and supplies Rental for mixer, motor, joists, towers Power and fuel Temporary buildings Stagings, ladders, and runs Sawmill			$2,300
Form lumber, 95M (less salvage)			5,000
Nails, oil and sundries			375
Metal forms erected	48	$18.30	875
Lumber, 2-in. spruce planks	17M	65.00	1,105
3-in. planks	1/1/3M	65.00	87
7/8-in. furring 2 x 4 studding 7/8-in. tongue and groove			50
1-in. maple flooring	10M	92.00	920
1-in. cork flooring	68 s. f.	.44	30
1-in. cell board	135 s. f.	.38	50
Building paper	76 rolls	3.50	266
Stair rail	80 ft.	1.00	80
Steel reinforcement	111 tons	80.00	8,880
Steel spirals	4 tons	100.00	400
Steel sash	6,800 s. f.	.353	2,400
Glass	6,100 s. f.	.13	800
Putty for glazing	3,200 lbs.	.06	192
Lime	4 tons	22.00	88
Terra-cotta blocks, 4 in.	5,400 s. f.	.12	648
Terra-cotta blocks, 6 in.	1,080 s. f.	.15	162
Nonpareil insulating brick, 4 in.	200 s. f.	.40	80
Nonpareil insulating brick, 2½ in.	160 s. f.	.30	48
Akron Tile Pipe, 8 in.	290 fl.	.30	87
Akron Tile Pipe, 6 in.	60 fl.	.20	12
Akron Tile Pipe, 5 in.	50 fl.	.20	10
Metal lath	8 s. y.	1.30	10
Sundry plaster materials			25
Freight elevator			3,475
Electrical contract			2,300
Heating and sprinkler contract			12,962
Plumbing			3,500
Cold weather materials			1,000
Liability insurance			1,500
Superintendent's salary, travel, board, stationery, office, et cetera.			1,600

ABERTHAW CONSTRUCTION COMPANY, Agent
Boston, Massachusetts

Job No._____ } To be marked on invoice
Order No. E4753 }

Vendor's Copy

PURCHASE ORDER

Date_____192____

To_____

_____

_____

Invoice to_____Owner
Aberthaw Construction Company, Agent
Mail invoice to Aberthaw Construction Company, Agent
Address_____
Send invoice in triplicate and address all correspondence as above

Ship to ABERTHAW CONSTRUCTION COMPANY, Agent
Address_____
Via_____
You agree to make shipment____
From your STOCK—MILL—
FACTORY_____
At _____
_____

PLEASE FURNISH THE FOLLOWING:

PRICE_____USED FOR _____BLDG._____
F. O. B._____RECEIVED_____REQ'N NO._____AUTH'N NO.___
TERMS_____BILL REC'D_____BILL O.K.'D_____

We reserve the right to cancel in case of delay.

Owner's Name_____
By ABERTHAW CONSTRUCTION COMPANY
Agent

By_____

This confirms our mutual_____agreement.

DETACH, SIGN AND RETURN ACCEPTANCE BELOW BY NEXT MAIL

ACCEPTANCE

Owner's Name_____ Date_____192____
ABERTHAW CONSTRUCTION CO., Agent

We accept your Order No. E4753, dated_____on your Form_____

_____

Form 9: Purchase Order Form

the daily "Material Received Form," showing the order number, description of the material received, the quantity, the vendor, the date of the invoice, the method by which it is delivered, and the charges; a column is also provided for remarks. When an invoice is received at the job it is checked against this material received sheet.

5. *Invoice Records.* After the invoice has been approved and passed for payment, it is entered in the "Invoice Record." There is a page for each vendor and all payments made are entered showing the invoice number, date, commodity, gross amount, deductions, discount, net amount, credits, number and date of check with which the invoice was paid, and the voucher number. The last column shows the statement number on which the invoice appears when the month's expenditures are reported to the owner.

6. *Material Cost Record.* The "Material Cost Record" consists of a loose-leaf book in which each item in the material estimate has a page and the estimated quantity, amount, and unit are entered at the top of the sheet. After the invoices for materials have been checked and paid they are entered in the "Material Cost Record." The date of the invoice, vendor's name, kind and quantity of material, and the cost are recorded. There is also a column headed "Outstanding Orders" in which the quantity of an order is entered in pencil as soon as it is requisitioned. When payments on these orders are made they are entered in ink in the cost column and the outstanding order figure reduced correspondingly. The next column is for credits and the last column shows the total cost to date.

Since this book contains all amounts paid for material on the job, the total of this book and the labor cost record at the completion of a job must check with the total cost as shown in the bookkeeper's ledger for the job. It is the permanent record of the material cost which is sent to the home office when the job is completed.

7. *Material Cost Statement.* In order to know how purchases for material compare with the analysis of the estimate of material cost, a statement which shows the overrun or saving on each item is made monthly. This form shows in successive

columns the item, the estimated and actual quantity, the estimated and actual cost per unit, the estimated and actual cost, outstanding orders, and the saving or overrun. In the estimated quantity column is entered the total quantity as shown in the analysis of estimate, and in the actual quantity column, the quantity for which payment has been made. The statement is made to show as nearly as possible what the final overrun or saving will be, as well as the overrun or saving at the time of the statement.

On the first three or four statements on a job that will require 10 or more months to complete, it is not possible to indicate clearly the savings or overrun that will show on the material cost at the completion of the work, because all purchases on the contract will not have been made. In addition to the outstanding orders being shown, the salvages and credits on plant and form lumber are estimated and included in the monthly statement. Three copies of this monthly material statement are made; two copies are sent to the home office, one for the general superintendent, one for the cost department; the third copy is for the job files.

Once the material is received on the job, no further record of it is kept. The foremen of the various crews are responsible for its economical use. If the material is short, the reason for it is ascertained by consultation with the foreman responsible. Sometimes an estimate is wrong, in which case the foreman is not responsible. If he has been careless, the fact is called to his attention. If there is a saving of material, this fact is known by its presence upon the completion of the job, at which time it is transferred to another contract.

To what extent should the method of accounting used by the Aberthaw Company be modified in its application to the needs of Foley and Johnson, assuming the latter firm follows the same practice of having the owner finance the disbursements currently?

4. PORTER ELECTRIC COMPANY—ACCOUNTING FOR RAW MATERIALS

In the manufacture of motors and signal equipment, it has been the practice of the Porter Electric Company to charge raw materials into manufacturing at a standard cost based upon the average price paid for each material during the preceding 12 months.

On account of price fluctuations, this system has caused a good deal of dissatisfaction. The company obtains much of its business by submitting bids for contracts: the standard costs are said to be of very little use in making estimates on which bids can be successfully calculated, and it is proposed that a change be made.

It is suggested that a committee of five department heads should set standard costs for the raw material. These men would not use necessarily any form of average or other arithmetical computation, but would rely mainly on their opinion as to what the price of each material should be under the prevailing conditions. As an aid to this committee in establishing the standard costs, the company will subscribe to the statistical service of the Harvard Committee on Economic Research, which forecasts business conditions.

The objections to the proposed method arise principally from the fact that the standard costs obtained will be subject to frequent and irregular change, and at best will be nothing but a matter of opinion. On the other hand, the system now used does not yield accurate costs. Towards the end of a year of rising prices, material is charged into product at a lower price than actual cost, whereas at a similar point in a period of price reductions, the charge to a job for material is more than competition will ordinarily bear, and the costs obtained have been of little help in making bids.

As an alternative, those who favor the retention of the present standard costs suggest an extension of that method, by which current records will be kept to show regularly the ratios of present material costs to the standards.[1]

These ratios, it is argued, could be used at any time to find the present cost from the standard cost. This group also favors the taking of the service of the Harvard Committee on Economic Research, but argues that it would be of benefit in fixing selling prices and making bids, rather than in ascertaining costs, which, they say, are facts independent of any prognostications of the future.

What method of charging materials into process should the Porter Electric Company use?

[1] *See* Harrison. *Cost Accounting to Aid Production*, pp. 84-87. Also Garry. *Multiple Costs*, pp. 30-36.

Will the record of ratios afford the most direct method of getting actual costs?

5. THE JOHNSON LEATHER COMPANY—ACCOUNTING FOR RAW MATERIALS

The Johnson Leather Company bought foreign exchange because of its intention to purchase leather abroad. At the end of 1921 it had a large balance in London, and the exchange rates had fallen. The company wrote off the loss on exchange as a cost of raw materials in that year, because of a doubt as to the possibility of future purchases.

Several executives of the Johnson Leather Company believed that the loss on exchange should have been charged exclusively against the materials bought in the foreign markets. Others stated that, since the funds in London at the end of the year could not possibly benefit the leather which already had been bought, a charge against that leather was not justified. It also was asserted that the loss should have been charged against future purchases, if any were made; otherwise it should have been charged off as an extraordinary loss to the surplus account.

How should the Johnson Leather Company have charged off the loss on exchange?

6. STOCKBRIDGE SMALL ARMS COMPANY—AUDITING BUILDING MATERIAL COSTS ON A COST-PLUS CONTRACT

In March, 1918, the Stockbridge Small Arms Company entered into a contract with the United States Government for the manufacture of a machine gun which necessitated the building of a new plant in Stockbridge. This contract called for payment by the Government for the expense of erecting the plant. The Stockbridge Company, with the approval of the Government, placed the order for the construction of the building with the Platt & Drew Construction Company of New York. To make sure that the true costs of building should be ascertained for payment, the auditor of the Stockbridge Company drew up a method of procedure to be followed by and between the Platt & Drew Construction Company (hereinafter called the Construction Company), and the Stockbridge Small Arms Company (hereinafter called the Superintendent), and the United States Government (hereinafter called the Owner).

In the outline drawn up by the auditor, the following methods for handling material and the accounting for it were included.

1. Material Division

Purchase Authorization

It is required that the Construction Company obtain three competitive bids, wherever possible, for all materials or work the value of which is estimated to exceed Three Hundred Dollars ($300). With respect to the freight charges involved, it is recognized that commodities are quoted upon varying terms of delivery, such as "f.o.b. point of shipment," "some stated freight allowance" or "delivered point of delivery."

There need be no uniform practice adopted with respect to the manner of submitting bids, but it shall be understood that all bidders must clearly specify freight terms, and in case of quotations other than freight allowed to Stockbridge, or delivered Stockbridge, that the vendors must supplement their bids with a figure representing the amount of freight that will be incurred. Bids or Purchase Authorizations are unnecessary for purchases of the estimated value of $300 or less. After receipt of the bids, they should be summarized upon the Purchase Authorization in quadruplicate, in the form prescribed, all copies of which should then proceed through the following channels for the purpose of authorization:

a. Rendered by Purchasing Department
b. Transmitted to Resident Engineer of Superintendent
c. Examined and approved by Resident Engineer of Superintendent
d. Transmitted by Resident Engineer of Superintendent to Resident Engineer of Owner
e. Examined and approved by Resident Engineer of Owner
f. Resident Engineer of Owner will retain for his files the original copy and distribute the remaining copies as follows:
    1. Duplicate copy to Construction Company (New York Office)
    2. Triplicate copy to Construction Company (Purchasing Department)
    3. Quadruplicate copy to Superintendent (Resident Engineer)

The Purchase Authorizations should be consecutively numbered and each number should appear upon its respective Purchase Order and Invoice to facilitate their identification with the Authorizations in which they originated.

Purchase Order

(a) The Construction Company may issue Purchase Orders for less than three hundred dollars ($300) without Purchase Authorizations, but when Purchase Authorizations are required, it shall be the duty of

the Construction Company to note upon the Purchase Order the Purchase Authorization number to facilitate identification.

(b) Certain provisions are made in the contract between the Construction Company and the Superintendent whereby the former is permitted to incur proper expenses in connection with the performance of this work. The Construction Company is required to issue separate purchase order on the regular form for all such expenses, to make possible a regular form of procedure for the auditing of these disbursements.

In the case of blanket purchases, such as telegraph service, telephone service, et cetera, blanket Purchase Orders should be sent to each vendor and each billing applying thereto should be posted by the Invoice Clerk to his copy of the Purchase Order, in the same manner as he will post all invoices of vendors.

Purchase Orders issued with Purchase Authorizations require to be approved in turn by the Superintendent and the Owner; the only copies that require that process will be Number 3 for the Construction Company and Number 8 for the Superintendent. All copies should proceed through the same process as Purchase Authorizations described in the first paragraph.

This form should be rendered in as many copies as may be required by the various parties, but at the present time it is thought that 12 copies are sufficient. These are printed and distributed as outlined in the following tabulation:

(a)

Color	Copy	For	Department	Printing on Reverse
White (orig.)	1	Vendor	N. Y.	Terms, etc.
Yellow	2	Construction Co.	N. Y. Office	Terms, etc.
Blue	3	Construction Co.	Purchasing Dept.	Terms, etc.
Pink	4	Owner	Mr. Greene	Terms, etc.
White	5	Owner	Mr. Greene	Terms, etc.
White	6	Owner	Mr. Greene	Terms, etc.
White	7	Construction Co.	Cost Dept.	Terms, etc.
White	8	Stockbridge Co.	Engineer	Terms, etc.
White	9	Stockbridge Co.	Invoice Dept.	Spec. ruling for Invoice.
White	10	Construction Co.	Invoice Dept.	Spec. ruling for Invoice.
White	11	Stockbridge Co.	Storekeeper R. C.	Spec. ruling for Store
White	12	Construction Co.	Storekeeper R. C.	Spec. ruling for Store

(b) The twelfth copy, which is for the receiving clerk of the Construction Company, will serve as the means of identifying shipments, the receipt of which will be recorded thereon; freight bills also will be identified with and posted on this copy.

(c) The tenth copy, for the Construction Company, will be utilized by the invoice clerk for the purpose of posting thereto the vendor's bills in the form prescribed, and for preventing duplicate bills being passed for the same material or services.

(d) The ninth and eleventh copies for the Superintendent are used

for auditing. The Superintendent also prescribes that the tenth and twelfth copies, in the hands of the Construction Company, shall both be filed by Purchase Order number.

(e) The Superintendent is not interested in other copies retained by the Construction Company and therefore does not prescribe any filing method for them.

Numbering of Purchase Orders

Purchase Orders must be numbered consecutively and must carry the number of the Purchase Authorization under which they are issued. No numbers must be vacant or unaccounted for.

Receiving Record

This record is provided in duplicate and should be numbered in series, prefixed by letters, so that the identification and sequence of reports can be established. It should be rendered by the Field Receiving Clerk upon receipt of shipments, and after their contents have been checked or counted.

Both copies should be forwarded to the Receiving Clerk for the following procedure:

(a) The original copy should be:

1. Utilized for comparing the quantity reported as being received with that billed by the vendor
2. Stamped by the Receiving Clerk as evidence of its having been checked with the bill
3. Submitted to the Superintendent's office for his stamp of approval
4. Filed with the Superintendent's (Receiving Clerk) copy of Purchase Order

(b) The duplicate copy should be retained by the Construction Company's Receiving Clerk for whatever purpose the Construction Company may require.

It is understood that the Construction Company will not sell or otherwise dispose of any material without first obtaining the approval of the Superintendent.

2. Accounting Division—Accounts Payable Division

Accounts Payable Voucher

(a) This form is provided in quadruplicate and is designed for its rendering by the vendor. Each Purchase Order should be accompanied by as many sets of these vouchers as, in the opinion of the Purchasing Agent, will be required for billings on the Purchase Order.

(b) The Accounts Payable Voucher set, upon its receipt, should be stamped with the date of receipt upon the original copy by the mailing department. The set should then be forwarded to the Invoice Clerk, to be treated as follows:

1. He must see that all information as to Purchase Order number, Purchase Authorization, delivery terms, et cetera, is properly entered in the spaces provided. The Invoice Clerk should also supply copies of the voucher to replace any that may be missing.

2. They should be checked against the respective Purchase Order as to accuracy of quantity, prices and extensions, and posted in brief on the reverse side of the Invoice Clerk's copy of the Purchase Order. Cash discounts should be calculated and deducted upon each copy of the voucher, and the net amount shown thereon, in order that only the net amounts of each bill may pass through the records. The foregoing should be inserted upon all four copies, but signatures certifying their accuracy should appear only upon the duplicate, triplicate, and quadruplicate copies.

Each day's accounts payable vouchers, after being checked and approved for accuracy, will promptly be numbered in quadruplicate and distributed as follows:

(a) *The Original* copy should be passed to the Accounts Payable ledger bookkeeper, posted to the ledger, and returned to the Invoice Clerk. He should then utilize this copy for the purpose of paying such bills as are subject to cash discount previous to the receipt of material (providing original Bill of Lading has been received) and stamping it to indicate the day on which the check was rendered. It is understood that arrangements can be made with local vendors whereby their invoices may be discounted at a regular date each month; it is expected that this arrangement will enable the Construction Company to receive the materials before paying local vendor's invoices. Paid and unpaid invoices should be filed alphabetically, prior to receipt of the material billed; after which the original, if unpaid, should be retained pending the payment of the bill. All paid bills on which material has been received should be filed numerically. The Invoice Clerk, who will have charge of the checking of vendor's bills, should provide files for active and closed Purchase Orders. As soon as an order is completed and billed, it should be removed from the active files and filed numerically in the closed files.

(b) *The Duplicate,* with triplicate and quadruplicate copy, is sent to the Cost Clerk for posting to his distribution files, then returned to the Invoice Clerk, who will forward the three copies to the Receiving Clerk where they should be retained pending receipt of the material, at which time the duplicate is receipted by him and returned to the Invoice Clerk. All copies should be transmitted to the Superintendent to be receipted and approved by him, after which triplicate and quadruplicate copies will be returned to the Invoice Clerk.

(c) *The Triplicate* copy should be used by the Construction Company as a supplement to its periodic bill against the Superintendent for disbursements.

(d) *The Quadruplicate* copy may be utilized by the Construction Company as it may require.

3. If an error is discovered in the bill as rendered by the vendor, the invoice should be returned to the vendor by the Invoice Clerk with the request that correction be made. Should an error in quantity or quality be discovered by the Receiving Clerk, he should make deductions, if possible, upon the face of the duplicate, triplicate, and quadruplicate copies, or by attaching a claim memorandum showing the reason for making a claim, thus drawing the special attention of the Invoice Clerk to such deductions. The latter should render Debit Memorandum.

Debit Memorandum

This form should be rendered in quintuplicate, numbered and registered in the same numerical sequence as the Accounts Payable Vouchers but entered in red upon the Accounts Payable Register and its distributions. The original copy should be forwarded to the vendor; duplicate, triplicate, quadruplicate and quintuplicate should be attached to the Accounts Payable Voucher copies and proceed through the same process as the copies of the Accounts Payable Voucher set.

Packing List

This form is provided in triplicate for attachment to each voucher payable. It contains a statement of the contents of the various packages in such form as to render checking easy. It should proceed through the same channels as the corresponding Accounts Payable Voucher, and eventually be attached to it.

Accounts Payable Register

(a) This form should be rendered in duplicate (for the use of the Construction Company) and provides for the listing of every Accounts Payable Voucher in numeric sequence by date of invoice, name of vendor, and net amount of bill. Provisions are also made upon this form to enable tracing of all copies of Accounts Payable Vouchers excepting the original, throughout the various stages through which they must proceed for various approvals.

(b) The tracing procedure will be that of treating the carbon copies of the Accounts Payable Voucher as a unit, and entering the date of their being forwarded to each department, as well as the date when they are returned from each department, to the Invoice Clerk. In other words, all the carbon copies should be forwarded to the respective departments through the Invoice Clerk, and in no case should one department pass the voucher to another department without first having it passed for record by the Invoice Clerk.

Accounts Payable Ledger

(a) It is required that the Construction Company maintain a ledger account with each vendor in the usual manner of keeping detail ledgers. Its entries will be obtained through the following media:

1. *Credits*—Original copy of Accounts Payable Voucher as outlined.

2. *Journal Entry Voucher*—Entries of this nature will be very rare, because it is the requirement that if possible all credits due vendors should pass through the Accounts Payable Register. When it is found necessary to pass a credit through a Journal Entry Voucher this form should be duly approved by the Superintendent, in the same manner as is required for his approval of Accounts Payable Vouchers. Occasionally there may be necessity for canceling a debit memorandum, which will require the crediting of the vendor. In such a case a debit memorandum should be used in its reverse form.

(b) Monthly this ledger should be balanced with its controlling account by requiring that the bookkeeper prepare a detailed statement of the ledger showing vendors' names and the balances of the accounts.

VOUCHER CHECK

This form should be rendered in triplicate—the details upon a typewriter and the written amount of the check upon a "Protectograph." It should be prepared from the original copy of the Accounts Payable Voucher in the case of bills paid prior to receipt of material, and from the triplicate copy of the Accounts Payable Voucher when drawn in payment of bills for which material has been received, and properly approved. The duplicate copy should be the medium for posting to the Check Register and afterward filed alphabetically with its respective vouchers, by the Construction Company, and the triplicate copy should be furnished to the Superintendent for its files.

CHECK REGISTER

This form need only be in a single copy and is for the purpose of recording daily from the duplicate copy of the voucher check the details of each check that is being paid. It should be totaled monthly for the purpose of posting to the controlling accounts, charging Accounts Payable and crediting Cash Account.

Are the provisions made by the superintendent for auditing the material accounts of the construction company effective for the purpose?

Construct a chart showing the origin, route, and final disposition of the forms used in this procedure.

7. THE NICOLLETTE CHEMICAL COMPANY—ACCOUNTING FOR SUPPLIES

The Nicollette Chemical Company is undecided whether to charge freight on supplies, expenses of handling, and storehouse expenses as an additional cost of supplies when requisitioned or to include these charges in overhead expense. These supplies consist of approximately 4,000 different articles ranging from

bricks and cement to small machine bolts, nuts, and washers. The company has always maintained a balance-of-stores control as a check on the quantity on hand and a guide for determining when to order. A cost accounting system which will provide detailed costs for both manufacturing and non-manufacturing departments is gradually being developed.

All supplies are purchased by the Purchasing Department in the city office. No purchases are made except on receipt of a purchase requisition signed by the storekeeper and approved by the factory superintendent. These purchase requisitions are made out in duplicate, indicating the quantity and description of the supplies to be ordered, whether they are to be delivered to the storehouse or to a department, whom to notify, and the account to be charged. The duplicate is kept at the plant, and the original is sent to the Purchasing Department.

When the Purchasing Department orders the supplies it sends a copy of the purchase order to the receiving clerk. The price and terms are included whenever known and also the route of shipment. When the supplies arrive, the yard teamster receives orders from the receiving clerk to deliver the goods to the place designated. The receiving clerk is responsible for the proper receipt of all supplies and raw materials, including all parcel-post packages. If supplies are delivered directly to a department, the foreman is usually made responsible to check the quality as well as the quantity received. In either case the check is made against the carbon copy of the purchase order, and any variation is noted. The receiving clerk reports to the purchasing department whenever goods are received, and no invoices are paid unless his report is satisfactory.

Supplies delivered directly to a department are not entered on the balance-of-stores records, but are charged immediately to the department on the voucher record, and the vendor is credited. Supplies delivered to the storehouse are charged to the storehouse controlling account and entered on the balance-of-stores cards.

Supplies are issued from the storehouse only upon receipt of a requisition order signed by the foreman of the department. Requisitions are made in duplicate, specifying the kind and quantity of supplies wanted, the department to which they are to be delivered, and whether they are to be used for maintenance,

plant construction, or manufacturing. The unit price and amount are filled in by the storekeeper. The original is filed according to departments, and the duplicate is filed by articles from which postings are made to the balance-of-stores card.

Most supplies are received in comparatively small quantities, but frequently brick, cement, lime, clay, and other bulky materials are received in carload lots. In 1921, 18 carloads of cement 4 carloads of lumber, and 2 carloads of brick were received. The freight on the cement was prepaid, but the total freight on the other 6 cars was $680, and the freight on all other supplies was $786.52. The total expense for freight, handling, and storing supplies, was $15,115.89 in 1920, and $13,346.76 in 1921.

An analysis of the requisition slips for 1920 and 1921 gave the figures reproduced below and summarized on the next page.

In October, 1921, when a salvage department was established in order to clean up the storehouse, supplies valued on the books at $3,892.18 were transferred to that department.

1920	Manufacturing Departments	Non-Mfg. Departments	Construction	Maintenance	Delivered Direct to Departments
January	$ 2,421.70	$ 2,684.50	$ 702.44	$ 3,849.50	$ 1,890.50
February	2,307.14	2,713.42	911.18	2,671.81	1,301.16
March	2,016.43	3,104.16	2,077.50	3,514.82	1,979.64
April	1,963.68	4,876.54	2,640.37	4,070.16	1.760.20
May	2,379.29	2,431.74	1,346.68	1,813.12	1,463.40
June	2,501.06	2,614.60	943.21	2,890.79	1,911.81
July	2,517.25	3,043.12	719.67	4,112.67	867.14
August	2,311.14	3,209.61	1,989.02	5,281.15	1,329.11
September	2,222.47	4,529.13	2,334.11	3,495.65	1,400.60
October	2,175.18	6,729.21	3,332.31	5,312.34	1,078.67
November	2,095.91	4,858.87	2,852.22	5,844.43	1,109.14
December	1,380.62	2,657.26	2,071.78	3,870.31	987.50
Total	$26,291.87	$43,452.16	$21,920.49	$46,726.75	$18,078.87
1921					
January	$ 1,224.76	$ 1,755.67	$ 673.83	$ 2,479.12	$1,039.74
February	1,330.01	2,257.59	800.68	1,670.29	1,078.78
March	887.03	1,614.47	269.15	2,559.22	990.91
April	643.63	3,660.49	1,113.34	2,420.80	1,027.62
May	1,166.64	2,317.89	1,247.98	3,525.39	1,026.88
June	1,018.25	1,965.03	630.36	2,555.87	1,133.68
July	1,209.65	2,221.27	784.98	2,490.97	229.81
August	949.14	2,134.37	1,242.10	2,404.59	303.50
September	1,033.62	2,340.99	521.75	3,607.33	284.48
October	1,430.68	8,954.82	896.43	5,454.36	283.71
November	1,518.29	2,983.96	873.05	4,484.52	636.28
December	1,145.22	3,032.40	720.38	5,067.11	309.05
Total	$13,556.92	$35,238.95	$9,774.03	$38,719.57	$8,344.44

Summary:	1920		1921	
Issued to Manufacturing Departments	$26,291.87		$13,556.92	
Issued to Non-Manufacturing Departments	43,452.16		35,238.95	
		$ 69,744.03		$ 48,795.87
Issued for Construction	$21,920.49		$ 9,774.03	
Issued for Maintenance	46,726.75		38,719.57	
		68,647.24		48,493.60
Total handled by Stores Department		$138,391.27		$ 97,289.47
Delivered Direct to Departments		18,078.87		8,344.44
Total		$156,470.14		$105,633.91

The storehouse control is kept in one account in the General Ledger. In order to localize any inaccuracies which may arise, however, the inventory of supplies is taken in 33 divisions. These groups, which are not rigid, are shifted whenever a better classification becomes apparent. The difference between these physical inventories and the book inventory is usually about 3% of the value of the supplies issued during the year. The book value of supplies is corrected to agree with the physical inventory by debiting or crediting General Profit and Loss Account. The number of units on hand of any article may be checked with the balance-of-stores card at any time. In order to save labor this check is usually made when the quantity on hand is low. An adjusting entry is made of the balance-of-stores card when it is incorrect. Both the book and physical inventories taken at the close of the fiscal year 1921 are given below.

Supplies	Book	Physical
Bags, Liners, and Twine	$ 147.01	$ 429.93
Bolts-Carriage, Machine, Stove, Nuts, Washers, and Lag Screws	1,107.99	1,258.39
Brick, Cement, Tile, Lime, and Clay	2,398.02	3,796.36
Carboy Stoppers, Washers, Wreaths, and Wire Closures	832.43	1,043.41
Drum Gaskets, and Bungs	46.92	134.26
Electric Supplies	1,452.54	1,719.83
Motors, Generators	5,004.14	4,894.14
Electric Wire	226.65	653.07
Elevator and Conveyor Spare Parts	949.01	925.56
Filter Cloth	3,642.53	4,050.09

Supplies	Book	Physical
Glassware	$ 897.44	$1,044.51
Hardware	1,578.56	1,886.13
Iron, Steel, and Shafting	503.80	620.97
Lead-Sheet, Pipe, and Miscellaneous	2,405.22	3,020.27
Lumber	658.25	1,034.55
Metals	125.41	112.10
Meters	6.00	6.00
Miscellaneous Items	1,370.31	967.35
Oils and Grease, Cotton Waste, and Wipers	368.60	403.49
Paint Materials	45.96	262.47
Pipe and Fittings	4,262.41	3,837.23
Pumps and Parts	3,290.81	3,390.45
Railroad and Crane Equipment	944.44	1,200.97
Rubber Goods and Sheet Packing	669.47	953.35
Raw Materials	34.23	59.48
Scales and Parts	1,324.55	1,182.02
Special Castings—cast iron	9,617.24	8,734.24
Compositions	686.44	739.19
Special Earthenware	10,111.84	9,002.19
Stoker Parts	851.56	841.66
Tower	841.17	927.39
Transmission, Gears, Sprockets, Collars, and Belting	3,068.40	3,187.40
Valves and Parts	2,710.01	2,908.93
	$62,179.36	$65,227.38

Physical $3,048.02 over Book

8. MAYFIELD-CARY SHOE COMPANY—CONTROL OF UPPER LEATHER

Requisitions for upper leather to the cutting department of the Mayfield-Cary Shoe Company always have been based on previous experience. When a new style was to be made, the foreman of the cutting department compared the requirements of the new shoe with an old style which had nearly the same requirements. If the actual record of a former style were desired, it could be obtained from the cutters' slip reproduced on the next page.

While this cutters' slip provided space for entries which could be used as standards and actuals, no effort was made to utilize those portions. The only part of the slip which was used was the first column.

Since the cost of upper leather constituted a large proportion

UPPER LEATHER

Stock_____ Cutter_____

Column 1				Column 2		Column 3				
Lot Nos.				Class No.						
Feet Given*				Allow Ft.		Hand		Machine		
Extra Given				Ex. Allow Ft.		Labor	Month	Day	Hour	Min.
Total Given				Total Allow Ft.		Start				
Returned				Used		Finish				
Used				Loss–Gain		Hours				
Price				Price		Price				
Total				Total		Total				

*This was an approximation made by a member of the production department or the foreman of the cutting department.

COSTS PER PAIR

Leather Cost			Labor Cost			Total Cost			Gain
									Loss

Case No.	Pairs	Pattern No. Top	Pattern No. Vamp	Allowance	Size	Price	Description

of the total cost of the shoe, economy in cutting upper leather had to be obtained in order to insure profits. Over 200 shoe plants had adopted a system which sought to minimize wastage

in cutting upper leather by setting up a standard for the number of feet of upper leather required in the manufacture of one pair of shoes. Size 5-D was taken as the standard size for women's shoes. Whenever a new style was designed, a pattern was sent to the headquarters of the system and the standard requirements of upper leather per pair were figured from actual tests. By a scale of corrections, the needs of all sizes and widths were computed. The firm that installed this system supplied its clients with a machine which computed rapidly the requirements of each production order.

In estimating wastage it was necessary to consider both the grade and kind of leather. The wastage in Russian calf skin, for example, is much less than in ooze [1] skin. The system took into account the kind of leather in its computations of requirements, for these requirements were taken from a test of the skin specified in the production order. In estimating variances in grades, however, it was necessary to scale the estimate up or down by fixed percentages, which were approximations based on general knowledge of the imperfections to be found in each grade. The estimates gave a standard for gaging the efficiency of each cutter, and made possible more accurate estimates of the cost of new styles.

The Mayfield-Cary Shoe Company manufactured medium-price shoes for women in a great number of styles—approximately 1,000 in 1921. It operated three factories with a daily capacity of 8,000 pairs. It also owned tanneries, which produced its entire requirements. Many of the skins produced by the tanneries were of such quality that it was impossible to cut vamps or tips from them. These skins were utilized in cutting up small patterns, such as inlays and collars. Frequently only one-fourth of the footage of the skin would be utilized. This was not caused by the inefficiency of the tanneries, but by the necessity of utilizing their entire product. In the normal run of skins a certain proportion of the product was of low grades.

Should the Mayfield-Cary Shoe Company have adopted the system of standards and actuals?

Draft a form of cutters' slip which would be suitable for use in the new system.

[1] Ooze skins are the flesh sides of split skins.

9. SARGENT MANUFACTURING COMPANY—DETERMINATION OF STORES QUANTITIES

The accountant in charge of installing a scientific cost system in the factory of the Sargent Manufacturing Company, producers of pipes, fittings, and small tools, in 1922 was working on a method of determining the stores quantities for its various products. The procedure that he submitted for the approval of the management used the sales of each product for the previous four years as the basis for arriving at the quantity to be manufactured the following year. The record sheet which he designed for tabulating these figures had ten columns, four for the sales of the previous years, five for percentages, and one for a weighted average quantity. The sheet for the year 1922 would have the following headings:

1918	Per Cent	1919	Per Cent	1920	Per Cent	1921	Per Cent	Weighted Average Quantity	Per Cent

The two columns at the extreme right were for the weighted average quantity and the percentage of each size of the total in this quantity. The accountant proposed to allow the last years to have the greatest weight in estimating the future production; therefore, in the calculations for 1922, the sales figured for 1918 would be multiplied by one; for 1919, by two; for 1920, by three; and for 1921, by four; and the total would be divided by ten, which was a convenient figure to use in order to determine the weighted average quantity, column 9. After the weighted average quantity of each size was found, the percentage of the weighted average quantity of each size to the total of the weighted average quantities would be entered in column ten.

From the figures determined by the method just described (Form 10), the balance of stores quantities was made out. The weighted average quantity was entered in column 2. The margin in column 5 was to allow for any unusual demand for a product. For example, if the weighted average quantity for a tool of a certain size was 1,200 per year, the average to be produced in one month would be 100; it might not be sufficient, however, to have only 100 made up each month with no reserve stock to cover unusual demands, and a margin of safety of, say, 50 might

NOTE: "Quantity to Order" is Quantity of Sales During Production Period (Black), Or Quantity for Economic Run (Red).

BALANCE OF STORES QUANTITIES

Production Period _____ Item _____

	Size	Weighted Average Quantity	Unit Weight	Control Weight	Margin of Safety	Quantity to Order	Minimum	Maximum	Weighted Average Quantity	Unit Weight	Control Weight	Margin of Safety	Quantity to Order	Minimum	Maximum	
TOTAL ITEM CONTROL WEIGHT																

Form 10: Sargent Manufacturing Company—Balance of Stores Quantities Form

ITEM

Date	Basic Minimum	Basic Quantity to Order	Date	Minimum	Quantity to Order	Date	Minimum	Quantity to Order

Group _____ Lot Number _____ Unit Weight _____ Economy Run _____

ORDERED						RECEIVED		ISSUED			BALANCE ON HAND			APPLIED		AVAILABLE OR SHORTAGE
Date	Quantity	Order Number	Received	Previous	Balance Due	Quantity	Price	Quantity	Order Number	Date	Previous	Present	Price	Quantity	Order Number	

Form 11: Sargent Manufacturing Company—Balance of Stores Card

be established so that 150 would be made the first month and 100 each month thereafter in order that 50 always would be on hand as a reserve. As outlined by the accountant, the reserve stock in any case would not be more than 100% of the weighted average quantity for a production period. The Unit Weight and Control Weight in columns 3 and 4 were used, not for computation of minimum and maximum quantities, but for assistance in summarizing the different sizes for control purposes. On the greater part of the stock with large sales the reserve would amount to 25% of the weighted average quantity. This low reserve was believed possible because of the fact that the larger the number of sales the more evenly they probably would be distributed throughout the production period. The quantity to order for column 6, therefore, would be 150 for the first month, if there was no previous inventory on hand, and 100 for the following months. The planning department should bear in mind the quantity most economical to produce in setting the minimum and maximum quantities to order. From the balance of stores quantities in Form 10, the basic minimum of 150 in the illustration would be entered on Form 11. This balance of stores card, Form 11, would be kept by a bookkeeping-machine operator in the general office who, besides making the entries on the cards, would note when the quantity available was approaching the basic minimum. If, for example, the basic minimum was 150 and the amount available was 155, the operator would fill out a notice of minimum to be forwarded to the order clerk in the planning department who would put through a production order.

The management was in some doubt as to whether it should accept the recommendations of its accountant, since the sales of two or three previous years would have no relation whatsoever to the sales of the next year, and the arithmetical computations recommended by the accountant could not be relied upon as a definite index for future production. Although several executives believed that the figures obtained by such a computation should be compared with estimates of probable sales submitted by the selling department, past experience had proved that the estimates of the selling department could not be relied upon to any extent. Since neither the arithmetical index of the accountant nor the estimates of the selling department would enable the management to make intelligent estimates of the quantities of each

product to be manufactured for future periods, a different procedure should be adopted. Those who held this view recommended that future production should be determined by studying the business cycle. For example, if, after a study of the best business forecasting services, it was believed that a 15% improvement might be expected in the following year, 115% of the output of the current year should be produced in the next year. The application of this method at the beginning was advised for all products, but it was suggested that an executive keep in constant touch with the conditions of production and sales during the second year so that he would be in a position to advise concerning cases to which this method could not profitably be applied in the future.

Which method of determining stores quantities should the Sargent Manufacturing Company have adopted?

B. INVENTORIES

10. DRUGGISTS' SUPPLY COMPANY—PERPETUAL INVENTORIES OF MATERIALS

The Druggists' Supply Company operates a large factory for the production of all types of supplies for retail drug stores. Patent medicines, tablets, lotions, perfumes, toilet preparations, and confectionery were included in the company's output. A complete system of perpetual book inventories was used in the factory, and the results obtained were checked each month by including them in the general financial records of the company through the financial ledgers of the factory.

There were five main production departments in the factory over each of which a general ledger control was kept. For the purpose of inventory control, each department was subdivided into three broad headings. The first, Raw Materials, showed in detail the various classes of raw material received, such as chemicals, containers, and literature, the latter consisting of labels, direction sheets and leaflets. The second division was for Partly Finished Goods or Compounds, containing pharmaceuticals, patent medicines, tablets, dry powders, and so forth. In this classification were included products which were made up

in large quantities by the manufacturing centers and kept in bulk until needed for distribution to finished stock. When this latter distribution was made, the partly finished goods or compounds were put into containers, such as boxes, bottles, flasks, and wrappers. For this reason it was really an intermediate storage between goods in process and finished goods ready for sale. The third heading was Production Centers. This was divided for the purpose of inventory control and overhead distribution into a number of centers, each of which made products of the same nature. For example, in department Number 1, there were production centers known as 1A, 1B, and 1C. All products manufactured in each production center were sufficiently similar in nature to allow for ready distribution of production expense.

When partly finished goods or compounds were delivered from the production center to the partly finished stock room, labor and overhead charges were included with the material charges at predetermined standard rates per unit. Finished goods delivered to the finished stock room had accumulated labor and overhead charges in each of the divisions through which they had passed. Thus the production department obtained full credit for all the expenses in addition to the charge for materials.

All raw materials were kept in one storeroom. More than 20,000 kinds of raw materials were used by the company. A perpetual inventory sheet with the headings Ordered, Received, Requirements, Withdrawn, and Value was kept for each material. Under the first four headings were spaces for the date, order or requisition number, and quantity. In the column for Value, the actual value of the materials on hand and the average cost per unit were entered. The balance available was shown as a balance under the heading, Requirements, the actual quantity on hand appeared as a balance under the heading, Withdrawn.

By the use of these sheets for every item a perpetual balance of inventory was maintained together with the value of the balance.

The inventory sheets were kept in the storeroom and also in the various departments. Much of the raw material could not be used in the manufacturing departments without being compounded according to formulas. In such cases standard amounts of the compound were made up in the storeroom and distributed to the departments in carefully measured containers. This action

was followed in all cases where it was advisable to have on hand in the various departments standard compounds which could be kept without risk of deterioration or spoilage. When a compound of this nature was received by a department, it was entered on a perpetual inventory sheet in the same manner as though it had been a raw material received from outside; actually, however, it was charged to the department only as used.

From the balances shown on the stores inventory sheets, the purchasing department was enabled to place orders so as to maintain the proper amounts of each kind of raw material. When goods were delivered, they were put in the storeroom and entered under the Received Column. After being checked as to amount and quality of materials received, the invoices were sent to the accounting department where certain additional entries were made for the guidance of the storekeeper. On the back of the invoice were entered the last balance on hand and the average cost up to that balance. The value of the new inventory was computed on a unit basis, and the quantity received was added to the former balance on hand. These amounts were added, and a new average cost was determined by including the value of the new invoice. The invoice then was returned to the storekeeper who placed the new average cost on his inventory sheet.

The books of the company were closed completely each month. In estimating raw materials on hand and goods in process, the balance of stores records only were used for determining inventory. No attempt was made at the monthly closing to take a physical inventory. Complete physical inventories were taken twice a year. Over a period of years the percentage of error between the physical inventory and the book inventory had been about ½ of 1 per cent. The average monthly inventory of the entire factory had been between $2,000,000 and $2,500,000. This percentage of error was not deemed in any way excessive, and more frequent physical inventories did not seem advisable. The nature of the raw materials and of the manufacturing processes aided in maintaining the book inventory within this narrow deviation from the physical inventory. It was essential that nearly all the raw materials used be weighed or counted out of the storeroom in an accurate manner. The liquids were measured by means of containers, and the raw materials were checked out

by weight or by unit with such care as to permit practically no errors.

Factory orders were made out according to definite schedules which provided for producing and distributing regular amounts of each of the supplies manufactured. The orders were drawn up on sheets which could be separated into three sections. One section specified the name of the finished product, the quantity to be produced, the formulas, and any necessary special instructions.

When detached, the second section became a requisition for raw materials from stores. When the storekeeper filled this requisition, he noted from it the department and subdivision to which the materials were issued, and marked on it the average cost per unit as shown on his inventory.

The third section also became a requisition for such standard compounds as already had been delivered to the particular department. Here again the storekeeper noted on the requisition the amount and average cost per unit of the materials supplied. From both types of requisition the storekeepers were able to show on their inventory sheets the exact description and quantity of the materials delivered.

In each department all the requisitions so filled during one day were gathered together according to the departmental subdivisions (1-A, 1-B, 1-C), to which the materials were delivered. The total values of these requisitions were entered daily on cards used only for that purpose. At the end of the month, a total value was secured of the raw materials issued to each subdivision from the daily cards.

In the general ledger of the company there were controlling accounts for each production department. Auxiliary departmental ledgers in turn controlled each departmental subdivision. At the end of each month the total from the daily cost cards of materials requisitioned indicated the amount of raw material delivered to the departmental subdivision. A further total for the entire department was made by adding the value of materials delivered to each subdivision. By adding the total value of deliveries made to all departments a factory total was obtained of materials delivered to the production departments. These deliveries were considered as purchases in each department and since the inventory at the beginning of the month and the amount of finished product made during the month were known, a new

total inventory was made available for the proper closing of the company's books. When each factory ledger was being closed, all other items of expense were included and the necessary figures were then available for debiting the controlling account in the general ledger with total expenses of production in each department and for crediting the controlling account with total value of finished goods delivered to the finished stock account.

II. KELTON INSULATED PRODUCTS COMPANY—USE OF PERPETUAL INVENTORY

The Kelton Insulated Products Company manufactured insulated wires for electrical purposes. Its purchases consisted of copper and copper wire, lead, cotton, and rubber, both in bulk and partly manufactured, steel tape, paints, chemicals, asbestos, and rope. Each of these materials was purchased in a variety of sizes and specifications so that in practice nearly 1,000 different supplies were used. The company maintained perpetual book inventories of all purchases, but did not have any means of connecting the book inventory with its financial records.

The factory was divided into the following eight production departments in which normally about 500 people were employed:

Mill Department	Braiding Department
Insulating Department	Twisting Department
Vulcanizing Department	Small Stranding Department
Testing Department	Cambric and Paper Department

The foreman in charge of each department kept a complete record of all materials received and used in his department. These materials were distributed to the departments after being received and checked, unless they were so bulky that it was necessary to store them temporarily in storage rooms. In either case the foreman was given a receiving slip so that he could enter on his inventory sheet the quantity of each material on hand.

The inventory sheets were arranged so as to indicate the amount due on orders already placed, the amount on hand in the factory, the amount required for orders received, and the balance available for each type of material.

Once each week the foremen submitted to the purchasing agent

a complete summary of the inventory sheets. The purchasing agent kept in a card index a separate card for every type of material. These cards were headed as follows:

Date	Requisition	Quantity	From	Invoice		Balance	Received	
				Date	Quantity		Date	Quantity

Entries were made on the purchasing agent's cards to show the factory requisition, quantity ordered, and source. Then, as the materials were received they were entered under the proper headings, and the balance on hand was taken from the departmental foremen's weekly sheets. When this balance reached the minimum set for a particular kind of material, a new order was placed and the proper foreman notified so that he might complete his record of materials due.

No allocation of materials to the specific orders in the factory was made for cost purposes. As materials were used, the foremen merely deducted the amount used from the balance on hand. Instead of building up a complete cost for each order going through the factory, the company had an estimating department which furnished customers with quotations on all goods called for. The estimating department was furnished with standard cost sheets which showed for each process the exact quantity of materials and value of direct labor which would be used in manufacturing a given type of wire. Thus on orders calling for this type it was necessary only to turn to the cost sheet for that type and note from it the total amount of each kind of material required to complete the order.

The purchasing department furnished the estimating department weekly with a sheet giving the price at which each type of material was to be charged in making quotations. The price shown was the current market price plus a small percentage for incoming freight and handling charges. The actual prices paid for materials on hand were not taken into consideration in any way in arriving at the price quoted.

The perpetual inventory sheets kept by the individual foremen did not carry the value of the materials and these records were used only as a guide to the purchasing agent. Physical inventories were taken at the end of the yearly accounting period, at which time it was usually found that the physical inventory

differed to some extent from the individual sheets kept by the foremen. In some items the discrepancy was large, and in others it was negligible. Either a shortage or an oversupply might be shown by the physical inventory as compared with the book inventory. No adjustments or reconciliations were made between the two inventories. The method of arriving at the cost of materials used during the year was to take the opening inventory, add the value of the materials purchased, and deduct the inventory at the close.

The purchasing agent felt that it was desirable to keep his records as simple as possible.

Should the company have included financial figures in the perpetual inventories and thus carried them through the financial records?

What method could have been used to tie the perpetual inventory records into the general books kept by the company?

12. BELL COTTON MILLS—ACCOUNTING FOR INVENTORY

The Bell Cotton Mills had followed a practice of keeping constantly on hand a basic inventory of raw cotton bought at the lowest price in order to meet unusual demands. Ordinary current orders theoretically were filled from cotton purchased specially for them.

In another factory the raw materials bought first were used first in the manufacturing processes. When inventory was taken, therefore, the number of units on hand was multiplied by the latest unit price paid or by the market price per unit, which ever was lower, in order to determine the amount at which the inventory should appear on the balance sheet. This method was required by Government regulation when returns for income tax were submitted. On the other hand, it was maintained that the only way to find the true net profit on an order was to charge that order with the actual expenses incurred for labor, materials, and overhead, and, since cotton was bought especially to cover specific orders, the ordinary procedure was not adapted to the industry. In fact, however, the older or the newer cotton might be used on any of the orders.

How should the Bell Cotton Company have priced its cotton for inventory purposes?

13. THE GIBSON BINDERY COMPANY—ACCOUNTING FOR INVENTORIES

The Gibson Bindery Company normally had on hand an inventory of bound books, parts of orders not ready for shipment, which had cost the company about $200,000 to bind. The management usually valued these bound books for inventory purposes at 66⅔% of the selling price because it was believed that more accurate estimates were practically impossible. If, for example, completed bound books, the selling price of which was $150,000, were in the bindery on the day when inventory was taken, Binding-in-Process was credited $100,000, and Bound Books debited with a like sum. When the orders for which these books were bound were completed and the actual manufacturing costs ascertained, the difference between the actual costs and the arbitrary credits was carried to an account called Cost of Bindery Sales.

It was suggested by several members of the company that, when inventories were taken, the value of books in process and bound books on hand should be estimated by comparison with the costs of similar books belonging to recent finished orders, and that any difference resulting from errors in estimating should be closed into the Profit and Loss on Manufacturing Account. This method would lead to more accurate inventory figures, and would put all manufacturing charges on the debit side of the manufacturing accounts where they belonged. These officials believed that, since selling prices were determined wholly by competition, the manufacturing department should stand all manufacturing charges and show a manufacturing cost which did not exceed 66⅔% of the selling price. The opponents stated that if the factory were operating with normal efficiency the selling department should secure prices which were high enough to allow 33⅓% gross profit.

Which method of treating inventory should have been used by the Gibson Bindery Company?

14. SHIELDS MACHINERY COMPANY—PERPETUAL INVENTORY FOR A FOUNDRY

The Shields Machinery Company, a specialized textile machinery manufacturer, made parts for stock and assembled the

machines upon the receipt of orders. This necessitated a large storeroom for worked materials. Total inventories of worked materials and purchased stores averaged between $400,000 and $500,000. In 1914 the company set up a perpetual inventory system for worked materials. Each part was assigned two bins in the storeroom, one an in-bin and the other an out-bin. Maximum and minimum limits were set for each part. Bin tags were placed on the outside of each container and all receipts and requisitions were entered on these tags. When a bin tag was filled or a bin emptied, the bin tag was sent to the balance-of-stores department and checked against the balance-of-stores sheets. At such times physical check-ups were made. On the balance-of-stores sheets for worked materials there were six columns: Ordered, On Hand, Apportioned, Available, Assembly, and Sales. The "Assembly" column was for parts delivered either to the sub-assembly, called the "parts assembly," or the machine assembly which was the final assembly for the finished product. The sales column was for the sales of parts for repairs. Annual losses from shortages before the perpetual inventory was installed had been as high as $40,000.

In 1919 the company built a foundry. Up to that time castings had been purchased and kept in a purchased stores storeroom. It was decided that in order to have a modern foundry equipped to handle the firm's requirements, and also to make it a paying enterprise, it would be necessary to accept outside jobs. The foundry, therefore, was treated as a separate factory with its own system of books and stores. Difficulties incident to the installation of a perpetual inventory system for the foundry were met in finding a suitable method of carrying those materials in which many grades were used. The most common materials used in the foundry were twelve kinds of pig iron, coke, scrap iron, scrap steel, sand, potting sand, molds, four grades of molding loam, blasting sand, fire clay, core oil, gluten, sulphuric acid, lime, steel plates, and cupola brick. Since pig iron was bought entirely by analysis as to content of phosphorus, silicon, sulphur, and carbon, it could not all be dumped in one place. To keep a perpetual inventory a balance-of-stores sheet was essential for each shipment of iron, and each shipment had to be kept separately. Although a carload ordinarily was used at one heat, in some instances, it was necessary to use portions of two or three

cars in order to get the desired hardness. The company could not check the weight of a car before the iron was used; consequently, the railroad weight was accepted as correct, and the check-up came when each charge was made. All withdrawals were weighed and charged by order number. Discrepancies were charged or credited to the last order. In the same manner, balance-of-stores sheets were made out for each type of molding loam and sand. The other stores came in uniform grades.

15. PARKMAN COMPANY—TIMBER LEDGER

In accounting for its timber limits in eastern Canada, the Parkman Company secures only the amount of lumber in each limit or each section of a limit for which accounting is done separately, but does not classify the amount of timber according to condition. The forester desires to have the system changed so that the amount of timber will be classified by types and the records will show whether it is virgin, on cut-over land, burned or windfall. He also wishes some method developed by which it will be possible to show the amount of growth increment in each limit each year.

In the left-hand column of Form 12, Timber Cut, is given the name of the contractor who has cut in the locality described in the second column. The amount of acreage cut over and the amount of lumber by species cut on timbered area, windfall, and on burned-over area are shown in the appropriate columns. One sheet is used for each limit or for each section of the limit for which separate accounts are kept. By means of these sheets it is possible to keep track of the total amount of timber cut each season on each limit owned by the company. At the end of each season this total is recorded on the timber ledger.

On the Timber Ledger, Form 13, is shown the total amount of timber on each limit owned by the company. Each limit is debited with the amount of timber on it at the beginning as determined by a cruise. It is credited with each season's cut in detail, a separate credit being given for the amount of timber cut by each contractor, jobber, or company camp operating on it during any year. Destruction by fire or unsalvagable loss resulting from windfall is also credited. The balance then shows the total amount of standing timber.

TIMBER

Limit Number

Contractor	Locality	Timbered Area							
		Acres	Spruce B. F.	Balsam B. F.	W. Pine B. F.	Jack Pine B. F.	Poplar B. F.	Acres	Spruce B. F.

Form 12: Timber Cut Form

TIMBER

Timber on limit

Item	Debits							
	Sq. Miles	Spruce B. F.	Balsam B. F.	W. Pine B. F.	Jack Pine B. F.	Poplar B. F.	Sq. Miles	Spruce B. F.

Form 13: Timber Ledger Form

The general manager has not yet been convinced by the forester that it is advisable to keep any more detailed accounts of the total amount of timber on the different limits. He points out the fact that it may be many years before other limits are cut, and that it is not necessary to know on these limits just how much timber there is by types. He also does not believe that it is possible, without great expense, to make any worthwhile estimate of the amount of growth increment on the different limits. He has not become convinced as yet that it is worth while to know the amounts of timber according to the different types unless operations are to be actually conducted during the coming year. In such a case, it would be necessary to send in either a cruising party or some one from the Woods Operating Department to make final arrangement for the operations on the limit.

What changes, if any, should be made in the system employed by the Parkman Company for keeping track of the amount of timber on its limits?

16. MADRID MILLS—INVENTORY OF GOODS IN PROCESS

Although only about 10% of the production orders of the Madrid Mills require the attention of the superintendent to keep them moving through the knitting mill, a new system is

CUT				Season					
Windfall				Burn					
Balsam B. F.	W. Pine B. F.	Jack Pine B. F.	Poplar B. F.	Acres	Spruce B. F.	Balsam B. F.	W. Pine B. F.	Jack Pine B. F.	Poplar B. F.

Form 12: Timber Cut Form

LEDGER									
Credits				Balance					
Balsam B. F.	W. Pine B. F.	Jack Pine B. F.	Poplar B. F.	Sq. Miles	Spruce B. F.	Balsam B. F.	W. Pine B. F.	Jack Pine B. F.	Poplar B. F.

Form 13: Timber Ledger Form

sought which will indicate more clearly the progress of orders, and at the same time give an inventory of goods in process.

Under the system in use the manufacturing processes for underwear are divided into seven departments:

1. Knitting
2. Bleaching
3. Cutting
4. Piecing
5. Flatlocking
6. Finishing Number 1
7. Finishing Number 2

All knitting orders are made out in the planning department on cards which indicate the serial number of the order, the knitter to whom it is given, the date, kind of fabric, size of machine, weight (inserted when knitted), date of going to cut-room stores, date of delivery to cutter, and the date cut. The order is given to the operative and returned by her when the tube of fabric has been knitted; it then goes to the Gray Room section of a file from which it is moved successively to the Bleach Room, Drying Room and Cut Stores sections, as coupons from the tag, which accompanies the roll, are sent in from the mill. These tags are fastened to the roll when completed and indicate the date and number of the operative for knitting, turning, bleaching, drying, and cutting, as well as the machine size, fabric, number of dozens cut, and weight. Two coupons are attached to the tag, one of which is detached when the roll is delivered to the Bleaching Room, and the other when the bleached roll is dried. The

remainder of the tag is returned to the office when the roll is delivered to the Cut Stores.

The remaining operations also are scheduled by the planning department. In the Cut Storeroom the fabric for each cutting order is placed upon a truck on which the order moves through the remaining processes. A Truck Card, which bears a serial number, the truck number, date, cutter number, season, tag (here is inserted one of the two brands which the mill produces), style, sizes, and remarks, accompanies the truck until the order is boxed and goes into Finished Stock. A Manufacturing Order with the same serial number as that of the Truck Card is then made out in the planning department; it bears the truck number, the date, the style, fabric, tag, season and cutter, as well as space for the number of dozens of each of the ten sizes which run from naught through to nine.

In a central space in the mill a "bulletin board" is kept with pockets for each of the one hundred different operations performed in the manufacturing processes after bleaching. A master chart also is posted here which indicates by number the processes through which each style of underwear goes. The first two copies of the Manufacturing Order are placed in the back of the pocket bearing the number of the first operation. As the operatives finish one truck they secure from the foreman the original copy of another order which is their authority for performing their part of the work. The duplicate copy remains in the pocket to indicate the disposition of the order. Each operative, before beginning, checks the number of garments which she receives on the truck from the preceding operator. The third copy of the production order is a card filed in the planning department. Each day a report is sent in from each of the five departments after bleaching which indicates the number of the orders which have been delivered to the next department and serves as a guide for changing the location of the cards in the files. Since these cards are filed by fabric, style, and number, the quantity of any style of garment in process can be ascertained immediately; also a lagging order is indicated by the gap in serial numbers of orders. If, for example, a production order number 6,700 of a low-neck, no-sleeve, knee-length garment of fabric M is found after production order number 9,700 for the same style, it denotes that order number 6,700 is delayed and an investigation is started.

In the New Cambria Mills, where hosiery is manufactured, a different method of controlling goods in process is used. From each of the fourteen operations a tag filled out in duplicate by the operative, showing the lot number, style and operator, is sent in to the planning department. Each tag is there entered on a master sheet which has columns on the left-hand side for dates, lot numbers, styles, cutters, and dozens, and spaces to the right for the date and operative's number for each operation through which the lot goes. Since the lot numbers are put into processes and recorded serially, lagging orders are indicated immediately by blank spaces, when subsequent lots have their record completed to a further point.

The inventory of goods in process in the underwear mill is secured from the cards. The vast number of fabrics and styles as well as the ten sizes and two brands make a detailed inventory necessary if excessive stocks are to be avoided and adequate control exercised. The inventory of goods in process in the hosiery mill is comparatively less complicated, since fewer styles and fabrics are manufactured. A careful count is required in the hosiery mill on account of the great hazard of theft, whereas in the underwear mill theft is negligible.

What system of controlling goods in process and obtaining inventories should the Madrid Mills use? How should the forms be drawn up?

17. THE ALESTES MANUFACTURING COMPANY—INVENTORY TAKING

The management of the Alestes Manufacturing Company wishes to develop a system which will insure taking an accurate inventory. At present the company is making 2,392 different articles such as hammers, saws, gimlets, screw-drivers, bolts, nuts, screws, safety razors and locks. Since its formation, the company has always maintained a reputation for producing high quality products. The present management, which has been in control for 22 years, has directed most of its efforts to maintaining this reputation, and very little attention has been given to any aspect of scientific management.

During the past year competition has been particularly severe, the result being that the books of account show a loss of over

$93,000. This fact, more than any other, has served to convince the manager of the danger of a lack of system. The slipshod methods of taking the inventory have been one of the principal sources of error and confusion. Not infrequently, after the inventory clerks have reported merchandise on hand, the shipping department has found that this merchandise was not available, because a mistake had been made in taking the count.

In the plant of the Gordon Electric Company over 6,000 different kinds of electrical equipment, including generators, dynamos, fans, bulbs, sockets, plugs, fuses, switchboards, and transformers are manufactured. Harvey L. Anderson, cost accountant for this company, has furnished the manager of the Alestes Manufacturing Company with a copy of the instructions issued to inventory supervisors at his plant. The Alestes Company's manager is considering how far these instructions, which are given in full below, will fill his needs, and how far they need revision.

General Inventory Instructions for Inventory Supervisors

Inventory cards will be sent to some of the departments. For the departments using cards, these cards are to be used merely for collating the final figures, and they must not be carried around the room. For the departments using sheets, these sheets are only to be used for collating the final figures. All original sheets and memoranda must be preserved until permission is given to destroy them. This permission must be obtained from the Cost Accounting Department.

Preparatory Work for Inventory

Previous to the taking of inventory the stock and workrooms should be cleaned up and all items stacked up in an orderly manner. Materials of like nature should be grouped in some definite arrangement so as to enable a rapid count to be made. Material hidden away in corners, and in similar places, should be brought out where it will receive attention. Dropped and slow-moving material should be stacked separately or marked in some manner so that a separate list of it can be quickly taken and *not* included with the regular inventory.

So as to avoid congestion and errors in inventory, all inter-department orders, stock orders, and the like, that are being held, must be priced and sent through to be charged *at once.*

Clerks should be properly instructed as to how they should count, enter, check, and the descriptions to give, so that the material can be properly figured. *Special care should be used with partly manufactured stock.*

Method of Taking

Material in all manufacturing departments, store or stock rooms

should be taken on the numbered inventory cards which can be obtained from the Cost Accounting Department. Definite series of numbered cards should be given to the clerk or clerks who are to list the inventory, and these should be receipted for and a record kept by the chief inventory clerks. The cards will be distributed by a responsible clerk who will place one card, in a conspicuous manner, on each bin, tray, or class of material. They are to be distributed in consecutive order throughout the entire stockroom so that when collected, it can be done in numerical order.

When the blank numbered cards have been distributed, the clerks will then count the material and enter on these cards, stating building, section, floor, order number if any, quantity, article, and complete description so that it can be properly costed. Entries as to quantity must be complete, and the clerks must designate whether units shown are for singles, 100's, M's, pounds, dozens, grosses, and so forth. Clerks should be given certain definite sections to take inventory so that no aisles or sections will be omitted or taken twice.

After the entries have been made some of the tags should be tested by the person in charge to see that the stock is being counted correctly. After all stock has been counted and the inspectors are satisfied that all items have been properly counted, the cards are to be collected in numerical order and checked to see that none are missing. All voided and unused tags should be accounted for and returned to the office. Inventory taking in large stockrooms should be started several days in advance. The departments must be very careful that all additions and deductions to or from the stock up to January 1 be made on the cards. This was done better last year, but there is still plenty of room for improvement.

All other material on the floor, benches, and so forth, is to be listed on the rough sheets of a uniform size and color which must be obtained from the Cost Accounting Department, care being used in stating units, descriptions, and so on, as mentioned above. Extreme care should be used to see that no material is overlooked.

Listing of Inventory

On Cards. For quantities collated and entered on the final inventory cards there should be one card covering all goods of one kind belonging to the same account, and a separate line on the card for each section and floor. The quantities on each card should then be totaled and multiplied by the unit cost. Additions and multiplications on the cards will be checked in the main office, but the quantities entered and the unit costs will be entirely up to you and the departments to get right. Also see that the account number entered at the top of the card is correct.

On Sheets. Quantities should be collated and entered on the inventory sheets according to building, section, and floor. No one sheet should contain items for more than one particular section or floor.

Only one item should be entered on a line.

As entries are made from the numbered inventory cards or from the original rough sheets, the items on the original data are to be plainly checked.

Every entry should be complete as to quantity and description so that there will be no doubt as to what the item is.

Write out the unit for every item. Do not use ditto marks in the unit column.

No writing should extend into the money columns.

Instructions given in the second and third sentences under "ON CARDS" apply to entries on sheets as well.

On both cards and sheets the entries must state whether units are singles, M's, dozens, and so forth. If the head of a column should read THOUSAND, the entry say for 1½M should not be written 1,500 because it is not known by the clerk extending whether this is 1½ M or 1,500 M.

Method of Pricing

Every cost entered on the sheets must specify whether it is for singles, dozens, grosses, 100's, M's, pounds, or what not. For special items figured on sheets where a *lot* cost is figured for the entire quantity, this total is to be entered on both the unit cost column, and marked "LOT," and again in the last extension column at the right of the perforation. For the first extension of the inventory sheets the amounts are to be entered in the outside extension column at the right of the perforation.

Part Shipments

All orders showing a record of part shipments having been made previous to January 1, 1921, must be charged to the Sales Division instead of taking them in the inventory. Where part orders have been shipped prior to January 1, you should advise the Accounting Department, giving them the name, order number, district, and state so that they can attend to the matter of charging the Sales Division. All such parts must be charged out by January 4, and after January 1 must be sent direct to the Accounting Department by special messenger.

Interdepartment Orders

All goods not actually delivered to other departments before January 1, 1921, must be taken in inventory by the department furnishing, and all goods delivered, whether taken from the trucks or not, must be taken in stock by the departments receiving. All vouchers received in the Accounting Department *prior* to January 5, will be considered as 1920 business, and no vouchers for 1921 must be sent through until January 15.

Dropped and Slow-moving Items

All dropped and slow-moving items charged off in previous years, for which we still have stock on hand, *should not* be taken in the regular inventory.

All dropped items which were dropped this year and not charged off, should *not* be taken in a regular inventory but must be listed separately and properly marked. This will include such items as boxes, cartons, lithographed tops, and cut stock as box forms, and so forth, left over that cannot be used on or for other merchandise. This must be in my hands by January 22, all priced, otherwise your division can receive no credit.

GENERAL

All data affecting inventory totals must be sent to me and not to the Accounting or any other department, as I am responsible for the inventory figures that are to be posted to the ledgers.

All time required to take inventory should be shown separately on the Payroll Distribution sheets under a column headed "INVENTORY TAKING." This applies to the clerical as well as to the stock taking and non-clerical help.

The inventory is practically the only figure which goes directly from this factory on to the company's books. It affects our profit and loss account, our account to the Government, and our insurance arrangements. Therefore, extreme care must be taken to get it right.

Please read these instructions over again and pay particular attention to instructions regarding showing locations, designating the unit of put-up, care of dropped merchandise, and additions and deductions for inventory taken previous to January 1. Many departments were careless on these points last year.

Please feel very free to ask any questions concerning methods, valuations, or any other point on which you may be in doubt.

COST ACCOUNTING DEPARTMENT
Harvey L. Anderson

18. THE X COMPANY—ACCOUNTING FOR DEPRECIATION OF INVENTORY

The X Company has always been careful to set aside reserves adequate to care for unusual losses from depreciation of inventory and has required a similar practice from its subsidiaries. At the close of 1921, however, the management was faced with the question of whether, under the existing unusual circumstances, one of its subsidiaries, The James Electrical Supply Company, should be required to assume a heavy charge against operating expenses for the year in order to maintain a reserve for merchandise depreciation.

The balance sheet as of December 31, 1918, showed a reserve for depreciation of merchandise of $47,000. Because of its failure to show a profit for the past 10 years a new management

took control in August, 1919. At this time it was necessary to revise the inventory account, because the book figures did not agree with the physical inventory, and a large amount of obsolete material had to be charged off. The merchandise statement at the end of the year showed the following situation:

Complete physical inventory at market	$179,500
Merchandise according to book account	187,000
Shortage between physical inventory and book account	$ 7,500
Reduction from current market to cost value	8,000
Depreciation write-off on inactive and obsolete material	5,500
Total shrinkage charged against reserve	$ 21,000

As a result of these operations the reserve for depreciation of merchandise December 31, 1919, was $26,000, which was equal to 14.5% of the active material inventoried. The auditors of the X Company recommended that a monthly addition to this reserve of one-half of 1% of purchases be made during 1920.

During 1920 the attempt to make all inventory active, which had been started in 1919, was continued. At the end of the year the inventory of merchandise had increased to $232,000. A statement of the charges against the year's income for shrinkage and depreciation of merchandise was made by the auditor of the X Company as follows:

Adjustments of value of inactive and obsolete merchandise	$17,000
Repairs to damaged material breakage, and so forth	2,500
Addition to reserve	500
	$20,000
Less:	
Overage disclosed by physical inventory above book inventory	$ 6,500
Adjustment of book value during year to reflect price changes	9,000
	$15,500
Total charges against year's income for merchandise shrinkage	$4,500

Although the reserve was increased to $26,500, it amounted to only 11.3% of the inventory, as compared with 14.5% in 1919.

During 1921 the company was forced to take heavy losses on its large inventory. The physical inventory of December 31, 1921, amounted to $143,000. The auditor's report showed that the following losses were taken:

Reductions to reflect price changes	$24,000
Shrinkage and breakage	1,000
Adjustment of book account to agree with physical inventory	14,000
Total inventory adjustments	$39,000

The reserve of $26,500 which existed at the beginning of the year was entirely depleted, and in addition $12,500 had to be charged to the year's operations to cover the loss for depreciation of merchandise.

In 1920 the new president showed a profit of $16,000 on sales of $1,300,000. With the exception of 1917, this was the only year since its incorporation in which the company had shown a profit. In 1921 because of the losses in inventory and the reduced sales due to the depression, a deficit of $13,000 on the year's operations was incurred.

Included in the auditor's report for the year 1921 was the statement:

"Had profits been available, it would have been advisable to have established a reserve for further merchandise losses of at least $20,000."

When the management of the X Company received this report, several of the accountants maintained that inasmuch as the James Electrical Supply Company had already borne much heavier losses from depreciation of inventory than had ever been incurred previously, it would not be wise to increase the deficit for the year by a charge against the year's operations for a depreciation reserve, especially since it might tend to discourage the new management. Prices of electrical merchandise, moreover, were stable by December, 1921, and further inventory shrinkage probably would not take place during 1922. Others asserted that, in spite of the heavy losses, the only sound policy would be to make further charges for depreciation in order to build up a reserve; that a mistake had been made in not adding more to the reserve during 1919 and 1920.

Should the officers of the X Company have recommended to the Board of Directors of the James Electrical Supply Company that a reserve for depreciation of merchandise be set up and charges made against the operations for 1921?

19. THE TOTTENHAM MOTOR COMPANY—VALUATION OF INVENTORIES

The violent fluctuations in material prices during the last few years have been a matter of grave concern to the directors of the Tottenham Motor Company, who desire to establish their business upon firm foundations and to eliminate as far as possible the disturbances caused by temporary conditions. The swing of the most recent business cycle has proceeded far enough to demonstrate that an inflated profit can be shown in the accounts for a period of high prices, only to result in a corresponding loss in a year of deflation. This situation has been found from experience to be disturbing in the costing of goods manufactured, and to the sales policy; still more important, such fluctuations are damaging to the financial stability of the firm.

With these ideas in mind a study was made of the facts and conditions relating to the inventory. The company has a scientific control of raw materials, finished parts, and work in process. In all stores departments a careful classification of materials and parts has been made, and maximum and minimum quantities for each item are in operation, so that when the stock of an article approaches the minimum an order for its replenishment is immediately issued. This means that the total inventories of the entire business cannot fall below a certain minimum, which is in the neighborhood of $4,500,000, based upon the prices of 1915. The maximum inventories permissible under the same plan and valued on the same basis amount to a total of $6,500,000. The actual inventory, at 1915 prices, usually ranges between $5,000,000 and $6,000,000, though the effort to purchase advantageously in rapidly changing markets sometimes has resulted in inventories which were higher than the normal maximum. The table at the top of the opposite page shows the basic inventories at 1915 prices and at current prices for the seven years ending 1921; and for the same years, the total actual inventories at 1915 prices, at current prices, and a composite valuation obtained by taking the basic inventory at 1915 prices and the extra at current prices.

Since the minimum inventory cannot be reduced or disposed of so long as the company continues to operate as a going concern, it is felt that this amount has to be regarded as a fixed investment attached to the business just as permanently as its buildings and

INVENTORY STATISTICS

For December 31	Basic Inventory 1915 Prices	Basic Inventory Current Prices	Total Inventory 1915 Prices	Total Inventory Current Prices	Total Inventory Basic at 1915, Extra at Current Prices
1915	$4,500,000	$4,500,000	$5,700,000	$5,700,000	$5,700,000
1916	4,500,000	6,500,000	5,900,000	8,500,000	6,500,000
1917	4,500,000	8,900,000	5,400,000	10,700,000	6,300,000
1918	4,500,000	8,100,000	6,200,000	11,100,000	7,500,000
1919	4,500,000	7,400,000	5,800,000	9,500,000	6,600,000
1920	4,500,000	8,300,000	5,500,000	10,200,000	6,300,000
1921	4,500,000	5,000,000	5,600,000	6,200,000	5,700,000

machinery. It is next pointed out that increases in the value of buildings and equipment are not—according to accounting principles and good business practice—taken into the operating accounts as a profit. The conclusion of the management, therefore, is that any increases in the market value of this minimum inventory should not be taken account of, but that the minimum inventory should be valued at a base figure, for example, prices of 1915; and that only the excess over the minimum inventory should be valued by the usual rule of cost or market—whichever is lower. The effect of this practice upon the net profits of the seven years in question is shown by the table below.

SHOWING DIFFERENCE IN NET PROFITS RESULTING FROM VALUING INVENTORY: (1) BY BASIC METHOD, AND (2) AT COST OR MARKET, WHICHEVER IS LOWER

Year Ending December 31	Excess, Current Valuation over Basic Method	Net Profits, by Basic Method	Net Profits, Inventory at Cost or Market
1915		$ 1,800,000	$ 1,800,000
1916	$ 2,000,000	2,300,000	4,300,000
1917	3,800,000	2,100,000	3,900,000
1918	3,600,000	2,400,000	2,200,000
1919	2,900,000	2,700,000	2,000,000
1920	2,900,000	2,000,000	2,000,000
1921	500,000	1,600,000	800,000 (loss)
Total	$15,700,000	$14,900,000	$15,400,000

It is contended that the adoption of this basic inventory plan would have the effect of charging all price fluctuations within a year against the sales of that year, rather than to carry them forward in the inventory and thus inflate the profits. It is generally recognized, both as a matter of business practice and economic principle, that selling prices will always be related to the

current market prices for materials, and not to the material prices of a more remote past.

It is recognized that the importance of this problem to any corporation will be in proportion to the ratio of its average inventory to its annual sales. Those companies whose inventories show a small ratio will suffer least from material fluctuations. The Tottenham Motor Company is not one of the most unfortunate in this respect, its inventories being normally from 20% to 25% of its annual sales; whereas in some industries the inventories run to nearly 100% of the sales; nevertheless the officials think their own statistics are sufficiently impressive.

In addition to the damage to the company's prestige arising from violent fluctuations in profits, there is a further disadvantage in connection with the income tax administration. The extra taxation incident upon years of increasing prices will not be compensated for by the decreased taxation in years when inventory losses are sustained.[1] The Treasury Department decided that the proposed method was contrary to the terms of the Revenue Acts of 1917 and 1918, and could not therefore be permitted in the income tax computations.

The Tottenham Motor Company, nevertheless, had confidence in the basic method of valuation from the point of view of sound business policy, and continued to use it until, during 1922, the market prices of many of its materials fell below those of 1915. It was then felt that the method had served its purpose and it was abandoned in favor of the usual practice. If any situation as abnormal as the war period should again arise, the company would probably resort once more to the basic inventory method.

What are the advantages or disadvantages of the basic method of valuing inventories from the point of view of general business stability?

What differences would it make in charging materials into process in the cost accounting records?

20. STAMPER MACHINERY COMPANY—MATERIAL INVENTORY SHORTAGES

The Stamper Machinery Company manufactured a special type of machine for textile manufacturers. The company manu-

[1] *See* article by George O. May, *Harvard Business Review*, October, 1922, p. 13.

factured parts for stock, but assembled machines only upon receipt of orders. A portion of the parts used for the construction of Stamper machines were bought, but the majority were manufactured in the company's own foundries and machine shops. Two storerooms were maintained, one for purchased materials called stores, and the other for manufactured parts, called worked materials. This demarcation was carried so far as to have two ledger control accounts and two individual groups of balance-of-stores sheets. The Stamper Machinery Company installed balance-of-stores sheets for the purpose of maintaining a perpetual inventory, but so many variances crept into the records that the balance-of-stores sheets and the bin tags usually failed to check, and the question arose as to whether or not it is worth while to try to keep a perpetual inventory under these conditions. These variances were of three sources: First, a miscount of materials received; second, an incorrect entry by an employee filling a requisition; and third, errors in addition or subtraction on the bin records.

Maximum and minimum limits were established for each part and controlled the purchase of all stores and the manufacture of all parts. The balance-of-stores sheets were divided into four columns headed: Quantity on Order, Quantity on Hand, Quantity Apportioned, and Quantity Available. All receipts and disbursements, with the unit cost of each item, were recorded on these sheets. Each part was assigned two bins in the storeroom, one an "out" bin and the other an "in" bin. Whenever a requisition was made, the amount was entered on the bin card and subtracted from the total which appeared. When one bin was exhausted or run down to a quantity lower than the succeeding requisition, the remaining parts were checked to ascertain if the total on the card corresponded to the physical quantity remaining. This remainder was transferred to the in-bin which contained the minimum plus receipts during the preceding period, and requisitions from that time on were filled from this bin. By means of this continual change, it was possible to have constant check-ups on the materials on hand. Whenever a bin was emptied or a bin card filled, the card was sent to the balance-of-stores department and checked with the balance-of-stores sheet.

Purchased parts were charged in and out at their purchase price. Manufactured parts, or worked materials, were charged in

and out at standard prices. The company had an efficient receiving department which received all purchased materials, tested the counts and made a report of receipts to the balance-of-stores department. When the materials were put in store it was possible to obtain a double check by the report from the storeroom based on the count of materials received. Double checks also were secured on worked materials by comparing the production reports of each department, as materials were finished, with the report from the storeroom. In spite of continual effort to insure correspondence between book inventories and physical inventories, discrepancies arose. Rarely were they more than two or three pieces, yet they occurred frequently enough to cause the Balance-of-Stores Department continual trouble.

What steps can be taken by the Stamper Machinery Company to remedy this situation? What accounting disposition of the differences can be made?

C. OTHER MATERIAL PROBLEMS

21. THE ONTARIO CAR WHEEL COMPANY—PRICE AT WHICH MATERIAL SHOULD BE CHARGED TO PRODUCT

The Ontario Car Wheel Company manufactures chilled-iron car wheels for steam and electric railroads and equipment manufacturers. The chilled-iron car wheel is used on freight cars and by some roads on passenger equipment. An ordinary iron wheel is too soft to stand wear and so a method has been developed to place an iron rim in the mold in which the wheel is cast which chills the hot metal when it is poured into the mold and leaves the casting with an outside rim of chilled iron which has excellent resistance.

The Ontario Car Wheel Company sells practically none of its wheels to equipment manufacturers; about 90% of its daily capacity of 700 wheels is for steam railroad consumption. Practically all of the equipment manufacturers make their own wheels which go on the new equipment sold to the railroads. The life of the wheels, however, is not so long as the rest of the car and they must be replaced at fairly frequent intervals. When an order is placed with a car wheel company for a specified tonnage

of new wheels, there is made at the same time a definite contract between the railroad and the car wheel foundry for the purchase on the part of the latter of an equal tonnage of old wheels. These old wheels form practically the entire material necessary for the manufacture of the new wheels. The price quoted to the railroad is based on the amount charged by the railroad for the old wheels plus a spread to cover the cost of manufacturing. Ordinarily the new wheels are sent out to the railroad from 60 to 90 days in advance of the receipt of the old wheels. Consequently, any one order must be made from scrap material furnished from some previous source. It has been a debatable point among accountants in the industry as to whether scrap material used in the production of any order should be charged at the old wheel exchange price noted in the contract price of that order, the base market price existing at the time, or the actual price paid for the material used.

The Ontario Car Wheel Company follows none of these three alternatives; it uses a system which has the disadvantage of being merely an approximation, but has the decided advantage of being simple to operate. At the first of the year, the company averages the cost of scrap material used in the production of wheels during the past year. This average price is used as the basis for all charges for scrap material going into orders for the coming year. At the end of the 12 months' period, a physical inventory is taken of the amount of scrap on hand and the loss or gain resulting from this method of charging material is charged directly into profit and loss.

The operations of the company in 1921 showed such a discrepancy between the actual inventory and the book inventory shown by this method because of the great variation in prices between 1920 and 1921, that the president requested the auditor to recommend some other system for the use of the company which would give more accurate cost figures and would still retain the advantage of simplicity.

The auditor has recommended the adoption of the system prepared by a committee of the Association of Manufacturers of Chilled Car Wheels which was adopted in principle by the Association on October 19, 1920. The following extract is taken from the report of the committee:

Old Wheel Exchange Account

Contracts for the sale of new wheels, particularly those to be used in the replacement of worn out ones, invariably specify that the Railroad furnish at a stipulated arbitrary exchange price a tonnage of old wheels equal to the tonnage of new wheels to be shipped under the contract. In effect, therefore, the Railroad agrees to furnish the metal required for the production of the new wheels covered by the sales contract. The obligation on the part of the Railroad to furnish old wheels, and on the part of the wheel company to pay for them at the stipulated price, is a definite and fixed one, and one which the books should record.

In theory, the old wheels to be received under a sales contract at a fixed exchange price will be used in the manufacture of the new wheels, but in practice it is generally the case that the new wheels are shipped out usually from 60 to 90 days in advance of the receipt of the old wheels. This necessitates the use of metal in the manufacture of the new wheels which has not yet been furnished under the contract, and which usually costs either more or less than the metal to be furnished under the particular contract.

If all exchange contracts with different roads entered into by the wheel manufacturer specified old wheels at a uniform price, the substitution of metal would be of no consequence as affecting cost and accounting methods, but where this is not the case it is very essential that the records reflect the difference in value of the metal actually used to manufacture new wheels under a given contract and the cost of the old wheels to be received under that particular contract. Otherwise, the wheel manufacturer may be in a position of substituting old wheels at a cost of say $40 per ton for wheels at $20 per ton provided for under the particular sales contract. This situation not only affects the true production cost but selling values as well, for in the above case the selling value is on the basis of old wheels at $20 per ton instead of at $40 per ton. Therefore, under sales contracts specifying the exchange of metal at varying prices, if the difference in metal is not taken into consideration, both production costs and selling values covering a particular period are inaccurately stated and comparisons are seriously distorted.

To facilitate the accounting procedure and to insure accurate and comparative costs and selling values the following sales policy and accounting practice are recommended covering the exchange value of metal:

1. In sales contracts with different customers specify the purchase of old wheels at a uniform base price, the price to be the approximate market value of old wheels at the beginning of the period covered by the sales contract.

2. In cases where sales contracts provide for the purchase of old wheels at varying prices and where it is not possible to secure from all roads a uniform old wheel price, the following accounting practice is

recommended in order to arrive at accurate and comparable production costs and selling values:

(a) At the end of each month prepare Old Wheel Exchange Summary covering all contracts having metal exchange clauses, showing weight of old wheels due at the beginning of the month and the value of the metal at exchange prices; weight of new wheels shipped during the month and the value of the metal therein at exchange prices; weight of old wheels received during the month and the value of the metal at exchange prices; and weight of old wheels due at the end of the month and the value of the metal at exchange prices.

(b) Open a ledger asset account entitled "Old Wheels Due from Customers" and a ledger liability account entitled "Old Wheels Redeemable Under Contracts" to record the value at exchange prices of all old wheels due under contracts from customers and the liability of the wheel company for payment. At the end of each month the asset account will be charged and the liability account credited with a value at exchange prices equal to the weight of new wheels shipped during the month. The asset account will be credited and the liability account charged with the value at exchange prices of old wheels received from customers during the month. The asset account, at the close of each month, will then reflect the value of old wheels due from customers at exchange prices, and the liability account will show the obligation of the wheel company to redeem the old wheels. The two accounts will always correspond in amount.

(c) New wheels shipped will be recorded at the invoice price, i.e., old wheel exchange price plus differential. If the base market value of the old wheels received or to be received in return for the new wheels shipped during the month is greater than the value of the old wheels at exchange prices, an account entitled "Contingent Metal Exchange" will be charged with the difference, and an account entitled "Sales Equalization" will be credited. If the base market value of the old wheels received or to be received in return for the new wheels shipped during the month is less than the value of the old wheels at exchange prices the account "Contingent Metal Exchange" will be credited with the difference and "Sales Equalization" account will be charged.

(d) Old wheels received will be vouchered at the stipulated exchange or invoice price. If the base market value of the old wheels received during the month is greater than the value of the metal at exchange prices, Old Wheels (stock account) will be charged with the difference and the Contingent Metal Exchange account will be credited. Any adjustment by customers in settlement of old wheels due at an exchange price below the base market price will also be credited to the Contingent Metal Exchange account. If the base market value of the old wheels received during the month is less than the value of the metal at exchange prices, Old Wheels (stock account) will be credited and Contingent Metal Exchange account will be charged.

In preparing monthly Balance Sheets, the Contingent Metal Exchange account, if a credit balance, can be deducted from the inventory of old wheels, and if a debit balance, can be added to the inventory of old wheels, or the account can be entered in the Balance Sheet as a separate item.

The effect of overshipments on the Old Wheels Due account and the Old Wheels Redeemable account as well as on the Contingent Metal Exchange account should be watched closely, particularly where the exchange price is in excess of the market price. The exchange records should be carefully and regularly scrutinized so that an overshipment may be promptly detected. The customer should be immediately notified of any overshipments and requested either to discontinue shipments or advised that overshipments will be applied on a subsequent contract for new wheels at the price to be stated in the later contract.

The following Journal Entries show how the data from the Old Wheels Exchange Summary would be recorded.

JOURNAL ENTRIES

Old Wheels Due from Customers	$79,375	
Old Wheels Redeemable Under Contracts		$79,375
To record old wheels due from customers under exchange contracts as of June 30, and our liability for payment.		
Contingent Metal Exchange	10,625	
Surplus Suspense Account		10,625
To record the contingent profit on old wheels due, as of June 30, at exchange prices less than market price.		
Old Wheels Due from Customers	46,000	
Old Wheels Redeemable Under Contracts		46,000
To record old wheels due from customers under exchange contracts on account of new wheels shipped during July.		
Old Wheels Redeemable Under Contracts	47,000	
Old Wheels Due from Customers		47,000
To record old wheels received from customers under exchange contracts during July.		
Contingent Metal Exchange	5,750	
Sales Equalization		5,750
To adjust sales under exchange contracts specifying old wheels at less than market to the basis of old wheels at market.		

	Old Wheels Contract Price		Old Wheels Due Beginning of Month		New Wheels Shipped During Month		Old Wheels Received During Month		Adjustments During Month*		Old Wheels Due End of Month†	
	G. T.	Cwt.	Weight	Amount	Weight	Amount	Weight	Amount	Wt.	Amt.	Weight	Amount
A. & B. R. R.	$16.80	$0.75	1,000,000	$ 7,500	500,000	$ 3,750	400,000	$ 3,000	.....	.....	1,100,000	$ 8,250
C. & D. Ry.	33.60	1.50	750,000	11,250	750,000	11,250	50,000	750	.....	.....	1,450,000	21,750
E. & F. R. R.	39.25	1.75	750,000	13,125	200,000	3,500	300,000	5,250	.....	.....	650,000	11,375
G. & H. Ry.	22.40	1.00	2,000,000	20,000	1,000,000	10,000	2,000,000	20,000	.....	.....	1,000,000	10,000
K. & L. R. R.	44.80	2.00	1,000,000	20,000	500,000	10,000	600,000	12,000	.....	.....	900,000	18,000
M. & N. Ry.	33.60	1.50	500,000	7,500	500,000	7,500	400,000	6,000	.....	.....	600,000	9,000
Total	.....	.....	6,000,000	$79,375	3,450,000	$46,000	3,750,000	$47,000	.....	.....	5,700,000	$78,375
Base Market Value	$33.60	$1.50	.....	90,000	.....	51,750	.....	56,250	.....	.....	.....	85,500
				$10,625		$5,750		$9,250				$7,125

*Any adjustment in weight allowed by or to the customer would be entered in the column provided, the value of the tonnage being entered at the old wheel contract price.

†In case of an overshipment under any particular contract, enter the weight and value in red and deduct when footing the columns.

Form 14: Old Wheels Exchange Summary—July 31

Old Wheels (stock account)	$9,250	
Contingent Metal Exchange		$9,250
To take old wheels into stock at market value which were received under exchange contracts at prices less than market.		

In reporting this system to the president, the auditor pointed out that although this was a more accurate system than the old one, the additional labor involved was not inconsiderable; and that in normal years the old system had proved thoroughly satisfactory. He therefore asked that the old system be left in operation and that if in the future extraordinary discrepancies occurred, the base average price be changed at shorter intervals to take care of the difficulty.

Should the Ontario Company have adopted the system recommended by the committee?

22. F. E. DEVEREAUX TIMBER COMPANY—CHARGING STUMPAGE FROM TIMBERLANDS TO MILLS

The instructions of the F. E. Devereaux Timber Company, one of the largest timber-owning interests in the country, for the preparation of the annual reports of its mills, read as follows:

Stumpage [1] will be credited as high as the business of the year will reasonably warrant.

In the past many operators who owned their own timberland did not consider that the original cost of the stumpage should be charged into the cost of the manufactured lumber because of the low price at which their timber properties were originally obtained; because of the rapid advance which had taken place in the value of timberlands; and because of the high percentage of overrun.[2] Since most of the large holders of timberland did little cutting on their lands, the increase in value of the stumpage remaining on their property had been such that the value of the property had usually been greater, even after considerable timber had been removed for current operations, than when the property was originally purchased.

[1] The term "stumpage" is used in the trade to indicate standing timber suitable for sawing into lumber.

[2] Overrun—The amount by which the scale of the lumber (feet board measure) produced from a given lot of logs runs over the scale of those logs as obtained by use of one or another of the various log rules in use.

Great increases in stumpage values have taken place. Figures given in the Report of the United States Commissioner of Corporations on the Lumber Industry give the advances in price for identical tracts of timber as follows:

State	Earlier Sale		Later Sale	
	Date	Amount	Date	Amount
By Tracts:				
Virginia	1902	$ 24,000	1906	$ 153,000
Washington	1901	127,500	1906	500,000
Washington	1900	6,000	1907	96,000
Washington	1900	11,840	1907	115,000
Oregon	1892	24,000	1907	460,000
Idaho	1901	240,000	1909	2,500,000
Per Acre:				
Louisiana	1882	$1.25	1909	$ 59.50
Arkansas	1900	1.00	1904	13.50
Wisconsin	1894	1.25	1908	30.00
Washington	1896	5.00	1908	108.75

From 1895 to 1897 one company made large purchases at an average cost of about 40 cents per thousand board feet. During the next four years the average price was about twice as great; during the three years following, three times as great; and during the next five years, five times as great. Moreover, the real increase was greater than this because the timber obtained by the earlier purchase was much more than was shown in the estimates, the estimates of the early years being exceptionally conservative. Like increases have taken place in all parts of the country and in almost all species of timber.

If the price of lumber can be advanced by the manufacturer it simply means a higher price for his timber. On a rapidly rising market the price of timber does not keep pace with the price of lumber, and some extra profit comes to the manufacturer as such. The rise is soon reflected, however, in the price of timber. Speaking broadly, it may be said that the price of timber tends never to fall. A fall in the price of lumber is believed to be only temporary, and the strong timber owner therefore awaits the future profit. Any temporary recession of lumber prices appears as a deduction from the profits of manufacture and his balance by the excessive profit made on a rapidly rising market. Thus during the boom years ending in the latter part of 1907, the manufacturer as such made high profits, for the price

of lumber was considerably in advance of the price of timber. Timber did advance considerably, however, and during the business depression which began toward the close of 1907 there was much complaint that the manufacturers were losing money because, speaking generally, timber prices did not fall, and the cost of manufacture was reckoned as including the timber prices established during the preceding boom in the market. Any manufacturer who had bought timber at those prices may have suffered an actual loss through cutting timber when the margin left for it from the price of lumber was less than the price paid; but nearly all the mills of any importance were cutting timber which they had bought years before at low prices, and were losing only in the sense of making less than the boom had led them to expect.[1]

If stumpage were to be credited as high as the business of the year would warrant, it would mean that, contrary to the general tenets of accounting practice, stumpage would in effect be carried at market even though the original cost price was considerably lower.

Was there any justification for the statement included in the instructions of the F. E. Devereaux Timber Company to its mills for the preparation of their annual reports that, "stumpage will be credited as high as the business of the year will reasonably warrant?"

How should the price to be charged by the company to its sawmills be determined for the stumpage coming to the mills from the timberlands of the company?

23. STAR SHIPBUILDING CORPORATION—METHOD OF HANDLING FREIGHT AND EXPRESS EXPENSE

The following quotation is taken from the *First Report and Recommendations on Uniform Methods of Cost Accounting in Shipbuilding*, May 21, 1919, of the Committee on Uniform Methods of Cost Accounting of the Atlantic Coast Shipbuilders' Association.

The cost of handling materials and supplies should be charged as part of general works expense. While in some cases it may be desirable to add such costs to the invoice cost of materials and supplies, it is suggested that for the purpose of simplicity and uniformity the method above recommended should be used.

[1] United States Commissioner of Corporations, Summary of Report on the Lumber Industry.

The Star Shipbuilding Corporation is a member of the Association, but has not seen fit to adopt the committee's recommendation of charging freight and express to general works expense. The instructions of the auditor of the company to his department include the following:

FREIGHT AND EXPRESS PROCEDURE

(a) *Freight.* Transportation companies shall be required to supply to the company at least one copy of a way bill or a billing memorandum in order that the company may be able to identify a shipment and to facilitate the passing of freight bills upon their receipt. The way bill should be in charge of the receiving clerk, who should enter thereon such matters of information pertaining to the shipment as will enable him to identify the purchase order, and to file it so as to facilitate the checking of freight bills and the applying thereto of the purchase order numbers. The freight bills should be rendered in duplicate, and handled as follows:

1. The original should be submitted to the transportation department for the approval of rates and then returned to the invoice clerk for comparing with the duplicate, the notation of accounts to be charged, and preparation of accounts payable voucher.

2. The duplicate should be forwarded to the receiving clerk who should apply thereon the purchase order number which he will transcribe from the copy of way bill which he should have received with the shipment. The receiving clerk should promptly return the duplicate copy of the freight bill to the invoice clerk.

3. Upon receipt of the duplicate freight bills from the receiving clerk, the invoice clerk should transcribe the purchase order number to the original copy of the freight bill. He should then refer to his copy of the purchase order to find out what accounts are to be charged.

The invoice clerk should arrange for prompt attention by the Transportation Department to the original and by the Receiving Department to the duplicate, so that he will be enabled to pass freight bills quickly. Care must be exercised by the invoice clerk to see that freight bills are passed only when proper; it frequently occurs that vendors fail to show freight as a separate item, even though they have paid it and included it in the bill.

The invoice clerk should enter the number of each freight bill and its amount upon the accounts payable voucher (duplicate, triplicate, and quadruplicate) in the space provided. Payment of freight accounts should be expedited and made to conform with the requirements of the local transportation companies.

(b) *Express.* When express companies deliver their shipments (inbound) they shall be required to furnish a copy of the statement of shipments so as to enable the receiving clerk to have a means of identifying shipments as well as to assist the invoice clerk in the passing

of express bills. This shipping memorandum should be attended to by the receiving clerk in the same manner as the way bills; namely—he should make a note of the purchase order number of each shipment and forward it to the invoice clerk. He transcribes this purchase order number from the shipping memorandum to the express bill, on which he also notes the account to be charged. This process should make quick attention to express bills possible.

It is understood that freight and express bills will be rendered almost daily so that an accounts payable voucher can be prepared for each set of bills. The distribution of freight bills can be made directly from the accounts payable voucher through the regular columns of the accounts payable register.

The materials, parts, structural units, and supplies bought by the company are:

I. *Materials*

- Raw Materials
- Metallic Materials
  - Metal in Pigs
  - Cable and Wire
  - Chain
  - Pipe and Pipe Fittings (exclusive of steel conduit and steel conduit fittings)
- Building and Street Surfacing Material (excluding lumber and metallic materials)
- Lumber
- Fiber Products and Insulation Materials
- Paints, Varnishes, and Glass
- Conduit and Conduit Fittings
- Scrap
- Miscellaneous Materials (not included in any of the above)

II. *Parts*

- Building and Cabinet Making Parts
- Motor Vehicle and Motor Boat Parts
- Structural Iron and Steel
  - Structural Iron and Steel
  - Structural Castings and Forgings
  - Other Castings and Forgings
- Engine and Machine Parts and Protection Attachments
- Electrical Parts
- Valves and Valve Parts
- Miscellaneous Parts (not included in the above)

III. *Structural Units Complete*

- Engine and Machinery Items
  - Main Engines and Turbines (includes condensers and propellers, shaftings and bearings)

Main Boilers, Auxiliary Boilers, Mountings and Attachments
Pumps, Tanks, and Auxiliary Machinery
Hull Machinery
Piping (includes Bilge, Ballast, Oil, Heating, Water, Steam, and Circulating Pipes)
Electrical Apparatus
Miscellaneous Engine and Engine Room Fittings
Hull Finishing and Outfit
Steel Hatches, Cargo Ports, Scuttles, and Doors
Lighting and Ventilating Equipment
Mast, Derricks, and Rigging
Warping, Towing Gear, and Fittings
Rudder, Boats, Life Rafts, and Davits
Furniture, Fixtures, and Miscellaneous Equipment
Standard Master's, Steward's, Carpenter's, Boatswain's, and so forth, Outfits
Miscellaneous Finishing and Outfit (not included in the above)

IV. *Supplies*
Fuel
Coal, Coke, Charcoal, and Wood
Liquid Fuels and Illuminants
Lubricants
Mechanical, Plant and Electrical Supplies
Mechanical and Plant Supplies
Electrical Supplies
Motor Vehicles and Motor Boat Supplies
Chemicals and Laboratory, Medical, and Photographic Supplies
Office and Drafting Supplies
Cleaning and Toilet Supplies
Forage and Other Supplies for Animals
Food and Household Supplies
Miscellaneous Supplies (not included in any of the above)

It is evident that the Star Company believes that the more accurate costs that can be obtained by the direct allocation of freight and express to the materials handled is worth the loss of the simplicity and uniformity mentioned in the recommendation of the committee.

24. THE BUSINESS RECORDS COMPANY—ACCOUNTING FOR FREIGHT AND EXPRESS

The Business Records Company, a New England corporation, manufacturing over 2,000 cards and forms for offices, charged all

inward freight and express to a stores expense account. All expenses of handling and storing raw materials before they were requisitioned for process were debited to similar accounts. At the end of the year these accounts were closed into the Stores Clearing Account. Whenever raw materials were requisitioned from the storeroom, they were charged out at their actual cost plus 5% for express and stores charges, and the latter amount was credited to the Stores Clearing Account.

Although the 5% for stores and express charges had corresponded so closely with the debits that, at the end of each of the five years during which this method had been in operation, little remained to be closed into the Manufacturing Profit and Loss Account, the company's accountant realized that the cost of raw materials and express charges did not always correspond. Frequently goods worth $1,000 weighed less than those bought for $100—and some raw materials, such as ingredients for ink, were purchased from foreign countries, whereas others were obtained within a few hundred miles of the factory. For about half the business, competition was so severe that accurate costs were essential so that the management could judge whether the manufacture of certain lines should be continued; but for the other half there was practically no competition. The accountant, therefore, wished to hire an additional clerk at $12 a week to figure the freight per unit on each inward shipment so that the raw material could be charged into manufacturing at the actual cost. He was willing to continue debiting the costs of handling stores on a percentage basis, because he knew of no other feasible way to do it. Since this was a time of recovery from business depression, the treasurer of the company was loath to employ an additional clerk unless it was absolutely necessary.

Should the Business Records Company continue to charge 5% for express and stores charges on all raw material requisitioned from the storeroom?

25. THE HARDING MOTOR CAR COMPANY—HANDLING OF USED CAR ACCOUNTS

In 1922 the reduction in price of many makes of automobiles was accompanied by such keen competition for orders that large allowances were given on used cars. The Harding Motor Car

Company which had the New England agency for the Windsor automobile, a car which sold at $2,430, had found it necessary to give allowances which were higher, after the cost of reconditioning and reselling had been added, than the price which could be obtained for the used car. The loss on used car transactions was considered by the management as part of the expense of selling new cars, but on the books no such charge had been made to sales of new cars. The manager was desirous of having the accounting system changed so that the complete cost of handling used cars could be ascertained.

The monthly statement made by the accountant of the earnings of the company showed the Sales Billed by each of the following departments:

1. New Cars, Retail
2. New Cars, Wholesale
3. Used Cars
4. Repair Department
5. Parts Department
6. Paint Department
7. Trim Department

The sales by the wholesale department were sales to local dealers in New England. Although a substantial portion of the work done by the repair, parts, paint, and trim departments was done on the demonstrating cars of the company and on used cars which had been accepted in trade, the sales billed as shown on the income statement included only those which had been made to outside customers.

The cost of sales billed was recorded on this income statement for new cars in both retail and wholesale departments, at the list price less the discount received by the dealer. The cost of used cars was made up from the used car ledger which charged to each used car received in trade the allowance made to the customer, the cost of the materials which went into the used car in reconditioning, and the charge for direct-labor hours spent on the machine. The cost for materials was based on the invoice price paid by the company and included no charge for freight, cartage, or expense of handling. Similarly, the labor charge consisted only of the time actually spent on the machine and included no allowance for overhead. The cost of sales billed from the repair, parts, paint, and trim departments consisted, as in the other departments, of the invoice cost for the materials and of the direct-labor cost, but included no charges for supervisory,

administrative, and burden charges. All such items as rent, and executive salaries, together with the commission paid to salesmen, payroll expense for foremen and for all employees in the plant not directly engaged in productive labor, were lumped in one class, the total of which was subtracted each month from the total gross profits for the various departments arrived at as shown above.

In the sale of used cars, other used cars were often accepted in trade with the result that the sale of one new car sometimes involved the handling of two or three used cars. In such cases the transactions of the various "trade-ins" were kept together in order to show the total loss or gain on the new car transaction. The allowance on used cars when the "trade-in" was made was set by the salesman, who used his own judgment about the condition of the car and the price which could be obtained for it. The company had not entered the agreement of Boston dealers by which the dealer promised to give no greater allowance than was provided on the scale drawn up by the committee appointed for this purpose, but the prices set by this committee were, in general, followed by the Harding Company. These prices usually followed a regular scale of depreciation which applied alike to all cars. These allowances were, however, subject to variations according to the condition of the car, and to the relation to current prices of new models.

It was the custom of the Harding Company to go over all used Windsor cars with great care, and to offer the same guarantee for service on these reconditioned cars as on new Windsors. When models of other makes than Windsors were taken in, the cars were sometimes painted and minor repairs made, but very little overhauling was done. If extensive repairs were necessary in order to sell the used car, the car was sent to the local dealer selling that make of car. The charges between dealers for repairs on used cars were at the same rate as the charges made by the dealers to customers.

The handling of used car transactions was done by the same force as new cars, and, with the exception of the charges for repairs and for direct labor on used cars, no division was made of the time of the office or shop force spent on used cars. Sales of used cars were made by the same salesmen as sold new cars, and at the same commission rates. Although during 1922 the

total sales of used cars both in number and in gross income was as great as for new cars, at times the demand for used cars was so great that it was not necessary to accept many trade-ins, with the result that the used car business was only a small proportion of the total business. The manager told the accountant that although it was not believed possible, under present conditions, to set an allowance on "trade-ins" at a point which would allow the used car transaction to show a profit, he was desirous of learning in each case what the actual cost of handling the used cars was.

How should the accountant change his accounts in order to provide this information? On what basis should used cars be charged for floor space and for administrative expense? What should be the basis of charge for parts and repairs?

26. THE ADAMSON ELECTRICAL COMPANY—MATERIAL WITH POTENTIAL USE VALUE

The chief accountant of the Adamson Electrical Company is undecided on the method of charging off some generators originally made for the United States Government on a war contract.

In 1912 the company began manufacturing electrical equipment on a small scale in a factory located near a small source of water power. Since the finances of the company did not warrant the development of this power, however, power was secured from the local public utility company at 5 cents per kilowatt-hour. During the war the company secured a contract from the Government for the manufacture of a special type of electric generator. In the course of operations there were a few of these generators produced which, although they functioned properly and were serviceable, did not meet the Government's specifications. The company was unsuccessful, however, in disposing of these special machines in the open market.

In 1921 when the radio boom developed, the company began the operation of its radio department all night. The power requirements of this department were small, since there were only a few drills to run and a few coil-winding machines. It was suggested that the surplus generators might be used in conjunction with the small water power available to supply the necessary power for running the radio department at night. When the

public utility company heard of this plan, it immediately offered a reduced rate of 3½ cents for the power, since it had a surplus between the hours of 11 p.m. and 7 a.m. This offer was accepted and resulted in a saving of approximately $300 a month.

The generators, however, still remained in good condition, and in reality were an argument against the public utility company to obtain a low charge for power. The following questions arose, therefore, in carrying the generators on the books:

Should the generators be entered on the books at $920, which was the contract price; should they be carried on the books at their scrap value of $78; should they be carried on the books at cost of manufacture, which was $734; or should they be carried on the books at the capitalized value of the savings which these generators made possible by the forced reduction in power rates, or should there be some other price? In either event, how should the depreciation be handled?

27. THE LOTT MOTOR CAR COMPANY— INTERDEPARTMENTAL TRANSFERS

The Lott Motor Car Company, which has the New England agency for the Herries automobile, accepts used cars in trade on about 80% of its new car sales. A substantial portion of the work of the service departments is done on service cars, on used Herries cars on which the same guarantees of satisfaction are given when they are resold as on new models, and on repairs that are necessary to prepare other makes of used cars for sale. The present basis of handling charges on these interdepartmental transactions is considered inadequate by the cost accountant.

Charges from one department to another are made at the same rates as to customers. Thus, parts for repairing used cars are charged by the parts stores to the used car department at the retail price, and the same rates for repairing, painting, and trimming are charged by the respective departments as if the work had been done for a customer. On the monthly earnings statement, however, the repair, parts, paint, and trim departments show only the sales billed to outside customers. Interdepartmental charges are brought together under the heading of "Sales to Departments." A cost of sales billed under this item is figured; it covers the invoice price of materials used and the

charges for direct-labor hours, but no charge is made for handling of materials, freight and cartage, supervisory and administrative expense, or general burden. The objection raised by the cost accountant to this method of charging is that the profit shown by the item "Sales to Departments" is fictitious, since it is made at the expense of other departments of the same company.

One of the alternatives considered is to charge to departments the same price as is now computed for cost of similar sales billed to customers. This method has the advantages of simplicity and uniformity. It is criticized, however, on the ground that it does not include all the costs of the service departments properly chargeable to other departments.

The Thompson Motor Company, which handles a car of the same price group as the Herries, has followed the practice of charging cars of one department for materials from another at the invoice cost plus an arbitrary 10% to cover the cost of handling, freight, cartage, and the like. Charges for work are made on a "cost-plus" basis. Direct-labor hours are charged at the rate paid to the workman, to which an overhead rate is added which is made up each month for each department on the basis of total productive hours of the department. This rate is applied during the following month to direct-labor hours and any adjustments for overabsorption or underabsorption are put into the overhead charges of the following month.

The objection raised to placing an arbitrary percentage on invoice cost for the costs of handling, freight and cartage, and the like, is that this method apportions the expenses unfairly between different classes of goods. Although most of the mechanical parts are bought from the factory, a large part of sundry supplies are obtained from local manufacturers, with the result that the latter frequently must carry part of the freight and handling charges of the former. It is obvious, furthermore, that since a light motor part might be invoiced at the same price as a heavy, bulky casting, it is not a true statement of costs to charge both the same for handling and freight. A more exact apportionment of freight, handling, and overhead charges to the individual parts would, however, incur serious additional clerical expense because of the large number of items handled.

What basis of charging "interdepartmental sales" should be adopted?

28. THE LATHROP SUPPLY COMPANY—COST OF SALES

The Lathrop Supply Company, a wholesaler of electrical apparatus and supplies, had not followed a consistent policy of determining the cost of sales. The ratio of gross profit to sales billed for 1917 showed an apparent decrease from that of 1916. This reduction was explained in the auditor's report of the company's operations for 1917 by the fact that during the greater part of 1916 an attempt was made to cost sales by using the average cost of the stock, while in 1917 latest market values were used. The sales billed in 1917 and 1916 and the gross profit were as follows:

Year	Sales Billed	Gross Profit	Gross Profit to Sales Billed
1917	$3,421,935	$556,865	16.3%
1916	2,206,051	384,423	17.4%

The inventory taken at the close of the year 1917 was valued at an average cost determined by a stock card analysis. No attempt was made to obtain a current market valuation, but comparison of the inventory prices with market quotations ruling at December 31 reveals that only in a few instances were market prices different from those used in the inventory.

The aggregate value of merchandise on hand, per the inventory was		$628,224.15
Goods in transit aggregated		85,294.97
Total merchandise on December 31, 1917		$713,519.12
The book account "Merchandise" after all adjustments had been made showed a balance of		645,967.47
Excess of inventory over book account		$ 67,551.65
Most of this excess was used to increase the reserve for loss on merchandise, which on January 1, 1917, showed a balance of		$ 90,000.00
Regular monthly allowance for depreciation ½% of sales		17,295.73
Excess of inventory over book account as above	$67,551.65	
Less portion used to establish reserve for loss on real estate and investment securities	8,065.93	59,485.72
Total reserve on December 31, 1917		$166,781.45

A number of reasons contributed to the large overage. The method of costing the previous year's inventory was the greatest factor, the costing having been at market values in effect November 1, 1916 (estimated to be about 10% lower than those prevailing on December 31, 1916). In costing shipments during the year 1917, however, latest market quotations were used. As no adjustment of the book account was made, this practice resulted in a constantly increasing over-liquidation of the merchandise account. Also, by reason of the necessity of placing orders months in advance of delivery, quantities of material were purchased at prices considerably less than the market quotations in effect when the goods were received. There was very little material in the inventory that could be considered slow-moving, and all obsolete or unsalable merchandise was included at *no value.*

In the audit report for 1916 the following statement was made:

The merchandise account at the end of the year should show no such large losses as experienced in past years, due to the advantage received by costing at current values, although purchases were actually made at the much lower prices prevailing in the latter part of 1915.

REFERENCES

A. ROUTINE PROCEDURE

BABCOCK, GEORGE D. "Taylor System in Factory Management," *Industrial Management*, Dec., 1916, pp. 339-354; Jan., 1917, pp. 534-554.

CARTWELL, M. *Stores and Material Control.* The Ronald Press Co., New York, 1922.

CHURCHILL, W. L. "Yield Value Variations in Woodworking," *Management Engineering*, July, 1921, pp. 17-21.

COGGESHALL, K. "Making Output Records Control Material Purchases," *Industrial Management*, July, 1922, pp. 6-11, 23.

CONNOR, W. N. "Construction Costs," *Journal of the Boston Society of Civil Engineers*, May, 1921, Volume 8, Number 5, pp. 178-195.

DICKSEE, LAWRENCE R. *Advanced Accounting*, pp. 56-64.

DIEMER, HUGO. *Factory Organization and Administration*, pp. 175-190.

DINSMORE, JOHN C. *Purchasing—Principles and Practice.* Prentice-Hall, Inc., New York, 1922.

DUNCAN, JOHN C. *Principles of Industrial Management*, pp. 262-280.

EGGLESTON, DEWITT CARL. *Cost Accounting*, pp. 115-162.

ELBOURNE, EDWARD T. *Factory Administration and Accounts*, pp. 153-167, 259-276, 465-470, 471-472.

FARNHAM, DWIGHT THOMPSON. "Principles of Purchasing and Storing," *Industrial Management*, Jan., 1919, pp. 33-38; Feb., 1919, 108-112.

FARQUHAR, HENRY H. *Factory Storekeeping.* McGraw-Hill Book Co., New York, 1922.

FARQUHAR, HENRY H. "Factory Storekeeping and Material Control," *American Machinist.* A series of articles running from May 4, to Aug. 3, 1922.

FARQUHAR, HENRY H. "How Do You Regulate Materials?" *American Machinist*, July 15, 1920, pp. 101-104; July 22, 1920, pp. 151-152.

JONES, EDWARD D. *Administration of Industrial Enterprises*, pp. 339-364. Longmans, Green & Co., New York, 1920.

JORDAN, JOHN P. and HARRIS, GOULD L. *Cost Accounting—Principles and Practice*, pp. 126-140, 376-388.

KICKMAN, J. G. "Keeping Track of Factory Material," *Factory*, March, 1919, pp. 465-469; April, 1919, pp. 702-707.
KIMBALL, DEXTER S. *Cost Finding*, pp. 59-109.
KRETSCHMER, E. E. "How Stores Are Accounted For on the Chicago Elevated Railroads," *Electric Railway Journal*, Sept. 30, 1922, pp. 510-14.
LAIST, T. F. "Material and Construction Costs," *American Contractor*, Oct. 21, 1922, pp. 22-25.
MARSHALL, P. M. "Aiding Purchasing Through Production Studies," *Management Engineering*, Oct., 1922, pp. 199-203.
MERRIAM, F. E. "Worth While Consideration in Stock Record Keeping," *Industrial Management*, Oct., 1922, pp. 190-205.
RINDFOSS, C. S. *Purchasing*, pp. 107-162. McGraw-Hill Book Co., New York, 1915.
SWEET, GUY V. "Purchasing and Handling Material in the Small Plant," *Industrial Management*, July 1, 1921, pp. 18-22.
SWEET, HOMER N. "Purchase Orders and Purchase Records," *N. A. C. A. Official Publications*, Vol. II, No. 7.
TWYFORD, H. B. *Storing: Its Economic Aspects and Proper Methods, with Illustrations and Forms.* D. Van Nostrand Co., 1918.
TWYFORD, H. B. *Purchasing: Its Economic Aspects and Proper Methods; with Charts, Diagrams, and Forms.* D. Van Nostrand Co., 1915.
VANDEVENTER, JOHN H. "Planning Production for Profit." Compilation from *Industrial Management and Engineers Magazine.* The Engineering Magazine Co., New York, 1921.
WHITTEN, H. J. "Seven Ways a Stores Department Helps to Cut Costs," *Factory*, March, 1922, pp. 282-284, 316.
——— "Balance of Stores Procedure," *Management Engineering*, Oct., 1922, pp. 253-256.

B. INVENTORIES

DAVIDSON, H. C. "Continuous Inventory for Gas Plants," *Gas Age Record*, 52 Vanderbilt Avenue, New York, Nov. 4, 1922, pp. 623-624.
JACKSON, J. HUGH. "Audit Working Papers," *American Institute of Accountants Foundation*, 1923, Chapter VI.
KILDUFF, F. W. *Standard Inventory Manual.* The Accounting Standards Corporation, Chicago, 1922.
KIEHNE, O. C. "Organizing for Taking Inventory," *Iron Trade Review*, Oct. 26, 1922, pp. 1125-1127.
LOWSON, F. "Cost or Market in Pricing Inventory," *Administration*, Dec., 1922, pp. 721-724.
LYBRAND, WILLIAM M. "Stock Accounts and Book Inventories," *Journal of Accountancy*, Feb., 1906, pp. 293-300.
MILLAR, THOMAS JOHN. "Materials-stock, Stock-taking, and Stock-checking, and so forth," *Accountants Magazine*, June, 1919, pp. 275-301.
MONTGOMERY, ROBERT H. *Auditing Practice and Procedure*, Volume I, pp. 122-150, 1922 Edition.
POTTER, M. H. "Organizing Modern Stores Department System Simple, with Few Form Cards," *Iron Trade Review*, Dec. 11, 1919, pp. 1586-1588.
RUSSELL, H. A. "Monthly and Yearly Inventories," *Industrial Management*, Sept., 1917, pp. 866-875.
SIMMONS, H. R. "Modern Stores System Proves Successful in Stay's Mill," *Iron Trade Review*, April 22, 1920, pp. 1197-1202.
SULK, R. "Accurate and Perpetual Inventory System," *Furniture Manufacturer and Artisan*, Jan., 1923, pp. 22-23.
SULK, R. "Ordering and Handling Frames in Factories," *The Furniture Manufacturer and Artisan*, Feb., 1923, pp. 89-91.
WELLINGTON, C. OLIVER; COAPMAN, C. W.; WARSHOW, H. T. "Actual Cost as Compared with Replacement Costs," *N. A. C. A. 1922 Year Book*, pp. 51-100.

WOODS, CLINTON E. "Elements of Inventory Control," *Administration*, Aug., 1921, pp. 181-214.
——— A pamphlet on *Perpetual Inventory or Stores Control*, Fabricated Production Department of Chamber of Commerce of U. S., Washington, D. C.

C. OTHER MATERIAL PROBLEMS

FARQUHAR, H. H. *Factory Storekeeping*, pp. 167-169.
JORDAN, J. P., and HARRIS, GOULD L. *Cost Accounting Principles and Practice*, pp. 113-125.
JONES, A. F. *Lumber Accounts*. Ronald Press Co., New York.
NICHOLSON, J. LEE, and ROHRBACH, JOHN F. D. *Cost Accounting*, pp. 127-129, 141-142, 186-187, 195.
SCOVELL, CLINTON H. *Cost Accounting and Burden Application*, pp. 28, 35.
"Stumpage Cost as a Present Factor in Lumber Prices," *American Lumberman*, June 1, 1918, p. 32.
WALTON, SEYMOUR. *Journal of Accountancy*, July, 1917, p. 62.
——— "Supplies and Spare Parts," *N. A. C. A. Bulletin No. 40*, Nov. 15, 1922, pp. 447-450.

III

LABOR—RECORDING AND DISTRIBUTING COSTS

1. ALDRICH MACHINE COMPANY—LABOR COSTS

THE Aldrich Machine Company makes a small assembly consisting of some 18 or 20 parts. It has in operation a regular cost system by which the time of work people on different operations is recorded, the present system of wage payment being piece-work for all direct wages, and time-work for all indirect workers such as foremen, inspectors, storekeepers, floor sweepers, and clerical help in the factory. Work tickets are issued for each operation. Parts are normally made for stock upon manufacturing orders, and the cost sheets are designed to show the monthly accumulation of all costs on all assemblies of each type which have been made during the month.

There has never been serious labor trouble at the Aldrich plant, as the proprietors have always maintained an open-minded and sympathetic attitude towards their work people. In pursuance of this policy, however, they are at present considering the construction of a composite method of wage payment which they hope will give recognition to all the principal factors commonly involved in a wage rate discussion. The scheme which has been tentatively proposed for this purpose is as follows:

The total wage shall be influenced by three major factors: first, the personal qualities of the individual workman; second, the output of the work-place or group with which the workman is identified; third, changes in the cost of living.

Suppose, for example, a workman's wage should at the outset approximate $30 weekly. It would consist, first of a personal base-rate of $15, and piece-work wages based on normal production which, if reached, would remunerate the worker to the extent of $15. If he failed to reach the normal production, this piece-work part of his wages would be reduced correspondingly. On the other hand, an excess of production over the normal quantity would yield him a higher return as far as this particular element is concerned.

Changes in the three elements of the total wage would occur as follows: the first part of the wage, giving recognition to the personal qualities of the workman, might be increased with every year of service; changes also might be made to give recognition to the workman's versatility, quality of work, cooperative spirit, initiative in making suggestions or improving methods of work, reliability, attendance, and so on. For employees not being trained, i. e., for experienced persons, this part of the wage would not be changed oftener than once in six months.

This same base-rate would also be used for calculating the allowances to be made for the purpose of giving compensation for changes in the cost of living. Every six months, or perhaps every quarter, one of the standard indexes of prices would be scrutinized and the base-rate would be multiplied by a factor proportionate to the amount of change. No change of less than 2% in the cost of living would be taken cognizance of; changes of 2% or more would be applied to the base-rate, the percentage of change being doubled in arriving at the multiplying factor, since the base-rate is approximately one-half of the total wage.

The piece-rate, forming the base of the second or production element of the wage, would, of course, be changed only under the same conditions as any other similar rate might be changed. In general it would be desirable not to change it at all unless some modification in working arrangements or mode of processing were introduced.

The operation of the proposed system may be observed from an example.

Case Conditions	Personal Base-Rate	Cost of Living Factor	Total Base Factor	Piece-Rate Earnings	Total
1. At beginning	$15.00		$15.00	$15.00	$30.00
2. Cost of living increases 3%	15.00	.90	15.90	15.00	30.90
3. Man re-rated, personal reasons	16.00	.96	16.96	15.00	31.96
4. Output increases 20%	16.00	.96	16.96	18.00	34.96

The proprietors have asked the cost accountant to make a report upon the accounting difficulties which would have to be met in operating a system of this sort. It is not, of course, ex-

pected that the cost accounting aspect will be the principal determining factor, but any serious accounting difficulties would have to be considered. The work ticket at present in use contains spaces for the man's number, man's name, date, the part name, the part number, the operation number, the name of the operation, the unit piece-rate, the number of pieces, and the inspector's signature.

Design a work ticket and a form of payroll which would be suitable in case the above wage scheme should be adopted.

Describe the methods by which the payroll would be accumulated each week, and how the operation and job costs would be accumulated for cost accounting purposes.

Point out any special difficulties which would be encountered in this procedure and make an estimate of their importance.

2. WAITE AND SON—FREQUENCY OF REPORTS ON LABOR COSTS

The detailed accounting system developed by Waite and Son, building contractors, provides daily labor costs of the individual jobs. In order to compare the actual costs with the estimates, the timekeeper must estimate the degree of completion of the work. The statement that $100 has been spent on erecting third-floor panels means very little to the person reading the report unless he knows how the job is progressing. The daily reports, therefore, include the estimated completion of each part of the job already worked on, some of the reports giving estimates on as many as 50 different items.

Shortly after the installation of this system, Mr. Waite decided that because so many reports were coming to his desk, he was unable to get a good perspective of the jobs. He asked for weekly instead of daily reports,[1] but the cost accountant, who

[1] The Baldwin Construction Company receives only weekly reports from its jobs. The management argues that daily reports mean nothing because it is impossible to deal with small fluctuations which are unavoidable. If a carpenter foreman is held up in his work because of the slowness of the steel crew ahead of him, his high labor costs will show up at the end of a day. Also it is impossible to estimate accurately the degree of completion of work. If a carpenter foreman erected all the posts necessary to place the forms for a floor before he sawed the upper ends, the timekeeper probably would estimate that the work was 75% complete, and not change his estimate for two days. Furthermore the preparation of daily reports also requires additional help on a large job.

The Baldwin Company keeps daily time sheets for all jobs, the hours of which are calculated daily and transferred to another sheet which enables quick com-

believed in frequent reports, suggested that the daily reports be continued and plotted on a graph. Mr. Waite objected to the graph because of the detail required, but it was pointed out that, because of the distance of some jobs from the office Mr. Waite could not visit them frequently, and the daily reports were therefore the only means he had of keeping in touch with the work.

Should Waite and Son continue the system of daily labor reports or should weekly reports be substituted?

What view would you take on the same question (a) in a factory where piece-wages were paid by operation; (b) in a repair shop where a daily rate was paid?

3. HAWLEY CONSTRUCTION COMPANY—ACCOUNTING FOR LABOR

The Hawley Construction Company of New York, specializing in the construction of fireproof factory buildings, never has kept detailed or cost records for either material or labor, although some jobs have cost $2,000,000 and over. The financial accounts indicate that the business as a whole has been profitable, but do not show whether or not individual jobs have been profitable. The success of the company is due probably to the fact that the management has acquired unusual ability in judging values and in driving bargains. Increasing competition, however, and reports of what has been done by other companies in the same field, have convinced the members of the firm that it would be desirable to have an accounting system to supply cost data on which to base future estimates.

In making estimates, the Hawley Company carefully calculates the quantity of material required, figures its cost, and adds a percentage to cover the cost of labor and incidental expenses. This percentage is determined from brief descriptions of total costs of material and labor on previous jobs kept on file, and

pilation of weekly costs of each kind of work performed. This total must agree with the total shown on the payroll. Although the information relative to costs is available each day, it is not reported to the head office until the end of the week. If the superintendent or anyone else wants to get the costs to date, he has all the information he needs except the degree of completion which he himself will have to estimate. At the end of the week the superintendent estimates the degree of completion of the work and sends a report to the head office. If this weekly report shows that any type of work is becoming expensive, that work is watched carefully. The cost accountant suggested special daily reports on such work as the weekly reports showed to be running over cost, but it was decided that it was the duty of the job superintendent at all times to watch the daily costs, and that daily reports for that purpose would be of little value.

may vary somewhat with the nature of the job. All clerical work connected with the office is handled by a stenographer; one timekeeper, who merely checks the presence of laborers and their idleness, does all the clerical work on a job. The only labor data recorded are the total hours worked; this total is multiplied by the wage-rate in order to obtain the total payroll cost. All contracts are taken on an outright bid which is determined by the rule-of-thumb method described above. The movement of material prices is considered; if they have increased rapidly, a safe margin is insured by the addition of an amount based entirely on the judgment and trade knowledge of the Hawley Company. The following description of labor records in the cost accounting system used by the Aberthaw Construction Company, Boston, has come to the attention of the Hawley Company.[1]

Labor Costs

1. *Summary of Estimate.* At the start of a job an estimate is made in the usual manner. This shows the actual take-off from the plans, with the items, quantities, units, and amounts. These units include the labor, material, overhead, and plant costs.

2. *Analysis of Estimate—Labor.* This estimate is then split into a labor and a material analysis. In the labor analysis these various items will show only the direct labor, with plant labor and overhead separated.

Opposite each item in the labor analysis is shown the symbol under which the working time is to be reported. This analysis is sent to the job, where it becomes the standard for labor cost comparisons on all operations of the job, and the estimate is not referred to.

One can readily see that, by separating labor and material, the work for the job superintendent in following his costs has been made much easier. He knows by the labor analysis just what figure the Estimating Department has set for the unit on each item. He is able to study his labor costs without being obliged to figure out his material, for the cost of which he is very often not responsible, as a great deal of the purchasing may have been done at the home office. He has condensed for him now these units for which he is responsible. If he thinks any of them too low, he can take up the case at once with the Estimating Department—and I must confess that this is done quite often.

3. *Timekeeping Symbols.* Most contractors use a series of numbers for reporting their labor operations, but Aberthaw uses a mnemonic code.

[1] *Journal of the Boston Society of Civil Engineers,* May, 1921, Volume viii, Number 5.

In the Aberthaw system the first letter is always a capital and indicates the kind of work to be done. For instance,

F stands for Forms — B, for Brick
R, for Reinforcement — D, for Digging, and so forth,

in so far as possible the first letter of the item represented being used. The second letter is always a vowel and explains the class of the work. The third letter, which is always a consonant, indicates the part of the building in which the work is being executed, as

f, floor; w, walls; c, columns; s, stairs.

As the code is the same on all jobs, our timekeepers and cost men quickly adapt themselves to any requirements of the work. If some work comes up not included in the code, a timekeeper can very quickly make up his symbol to cover it and it can usually be interpreted by the cost men. If necessary, an explanation may be written opposite the item the first time it is reported.

A real feature of this code is the manner in which it helps visualize the work. For instance, with numbers one might have 21.1 as a symbol for erecting brick walls. How much better the symbol Bew,—"B" brick, "e" erect, "w" walls.

4. *Timekeeper's Field Sheet.* To report the time and distribution of the men, the timekeeper uses a field sheet which shows each man's number in the left-hand column.

These sheets are in two series, one running from 0 to 50, and the other from 51 to 100, and the numbers are printed on the sheets, so that if a job has a series of checks numbered from 1,200 on, the timekeeper needs only to write in the number 12. The next columns show the time at which the men reported for work and the time at which they quit work.

Then there are 11 columns, each one representing one hour's work, and headed 7-8, 8-9, 9-10, and so forth, up to 5-6. In these spaces, after each man's number, is written the symbol for the type of work performed. If one man is erecting forms from 7 to 12 continuously, the symbol "Fef" would appear in the first hour column and a dash in each succeeding column up to 12 o'clock. Then he might change and work at erecting wall forms to 5 o'clock. In such case the symbol "Few" would show. The timekeeper makes four checks a day, and if the men have changed their class of work between checks, he confers with their foremen as to the hour when changes have been made. The remaining columns show the rate, then the amount earned and the actual hours worked divided into regular and overtime.

We have, therefore, on this timekeeper's field sheet a complete record of each man's daily time and class of work performed.

This field sheet is the same length and ruled the same as is the payroll sheet. We can, therefore, in transferring the time from this field sheet to our payroll, simply lay it down on the payroll sheet and copy the figures on the lines which coincide. This offers a great saving of

time and is much more accurate than calling the time off, or transferring it by comparing the men's numbers.

The type of ruling on forms is a very important item. Those forms which are to be used together should be, in so far as possible, ruled similarly. This fact I do not believe is usually given the emphasis that it deserves.

5. *Waste Sheet.* The office cost man, with the timekeeper's field sheets before him, now uses a sheet which is called a "Waste Sheet." He combines all the "Fef," "Med," "Ref," and so forth, symbols of the Field Sheet and figures the total daily expenditure under each symbol. These amounts he enters each in a column headed with its proper symbol. The total should check with the total daily payroll.

This sheet is ruled for seven days. It is kept up to date daily, so that at the end of the week the cost man has the total weekly expenditure for all the symbols under which work has been performed. The quantity man gives him the quantity of work accomplished, which he enters under the total weekly cost of the "Waste Sheet" and then figures the unit cost and writes that under the quantity. He then has under each symbol the total weekly expenditure, weekly quantity, and weekly unit.

6. *Labor Cost Record.* The next step is to transfer these items to the Unit Cost Record Book. This is a loose-leaf ring binder, carrying a sheet for each symbol. The first column of the sheet shows the date of the week ending; the second the weekly cost; the third the weekly quantity; and fourth the weekly unit. These items take up about one-half of the sheet. The other half shows the cost to date, quantity to date, and unit to date. As a partial check on these items there are included two columns, one for number of barrels of cement used, and one for cubic feet of concrete per barrel. At the top of the sheet, directly over the quantity, amount, and unit to date column, is a space to write in the estimated quantity, amount and unit, so that these estimated figures can be compared with the actual figures at any time.

This is kept up to date each week, and is checked against the total payroll of the job. This book is the permanent record of the labor costs and is sent to the home office at the completion of the job.

7. *Labor Cost Statement.* We are now ready to make out the Weekly Labor Cost Statement. In this, first the symbol is shown, then the kind of work, next, the weekly cost, and weekly unit. Succeeding columns offer a detailed comparison with the Analysis of Estimate—the estimated quantity unit and cost being set against the actual quantity and unit and cost attained in operation. The last two columns give opposite each item, in one case, the overrun; in the other, the saving.

As an illustration:

Suppose we have listed in our analysis of estimate 1,000 cubic yards

of concrete under the symbol "Med," at a unit cost of $1.50 per cubic yard. By the fifth week of the job there has been completed 700 cubic yards at a unit cost of $2.00 per cubic yard. Seven hundred cubic yards at $1.50 would be $1,050, which would have been the expenditure on that item, provided the work had been done at the estimated unit of $1.50. But actual cost is $2.00 per cubic yard, which means an expenditure of $1,400, or an overrun of $350 on this item. If it had been done for a unit of $1.00, there would have been a saving of 50 cents per cubic yard, or a total saving to date of $350. Each item is figured out similarly, and the difference between the saving and overrun is shown in the proper column.

For those items on which no quantity is reported, as plant, watchman, overhead, and so on, a percentage is used. For example, if $1,000 is allowed for overhead and the job is to last 10 weeks, this overhead will average $100 per week. If, after the job has gone 6 weeks and $700 has been expended, and it is figured that $450 more will be expended, the overrun will be $150; and this is shown.

The labor cost sheet gives the costs in detail for the job superintendent to study, and informs him just where he should concentrate and what he should study. If 75% of his total overrun is in two items, the place for him to remedy his high units is clear. Without some such data how can a superintendent intelligently talk to his foremen or know his job?

8. *Labor Comparison.* In order to condense this report for the management, a comparison of savings and overruns is made, listed under the various symbols. All the overrun or savings on one class of work are totaled, and the total overrun or savings shown as concrete, forms, reinforcement, and the like. The record of the previous week is also shown so it may be compared with that of the current week.

The Labor Cost Statement, together with this labor comparison sheet attached, is sent into the main office each week so as to reach there not later than the Monday morning following the closing of the payroll. One copy goes to the general superintendent and one to the Cost Department.

9. *Payroll Sheet.* The payroll sheet is ruled for seven days, with two columns for each day—one to show regular and the other overtime hours. The regular and overtime hours are extended and shown in separate total columns, as also are the regular and overtime rates, the total amount earned for the week being in the next column.

The man's name and number appear in the extreme right-hand column. This, I think, is rather unusual, but we find it much better when paying off, as the person paying need only look at the next column and not from one side of the sheet to the other to check the name and amount, which lessens the danger of errors considerably.

So much for the labor cost records. Their handling is so standardized that we can transfer our cost men, if necessary, to any job, and they can readily pick up another timekeeper's or cost man's duties.

To what extent should the Hawley Construction Company adopt the labor records used by the Aberthaw Construction Company?

Would there be any special difficulties (a) in operating the system; (b) in interpreting the resultant figures?

4. RED METAL MANUFACTURING COMPANY—ALLOCATION OF WAGES

The earnings of skilled workmen in the brass and copper rolling mills of the Red Metal Manufacturing Company were computed from an hourly base-rate for a set normal production, and a bonus was added for production in excess of the normal. No minimum was guaranteed to the workmen when on familiar work, and if things went wrong and less than the normal amount was produced, the weekly pay was reduced by the amount of the shortage in production figured at the base rate. Such deductions were rare and on many jobs skilled workmen made a considerable bonus.

In times of low production, in order to retain the services of the skilled men, it was sometimes necessary to place them part of the time on work with which they were not familiar and in which they were not especially skilled. In such cases, they invariably did not reach normal production and a large labor charge was incurred by the department to which they had been shifted, since under these circumstances they were guaranteed a minimum wage equivalent to normal production of a skilled man figured at the base-rate. Labor was charged against product on a flat rate which had been shown by experience under normal conditions to be approximately equal to ordinary direct-labor costs; when, therefore, an excessive charge had been incurred by placing a man on unfamiliar work, it showed up in an unabsorbed labor balance in the department to which the man was shifted. The foreman of that department objected to this arrangement, as his department made a bad showing when the unabsorbed labor and burden accounts were used by the management as an index of a department's inefficiency and idleness. He said that it was no advantage to his department to have their services, since his own regular labor was less skilled and could be discharged more readily in times of depression. It was suggested that the difference between the actual labor cost in case of shifted men and the

normal rate at which orders were charged for a job should be charged to the department to which the men belonged as skilled workmen, the extra cost thereby appearing in the unabsorbed labor account of the department where idleness required the shift. The latter department insists that the unabsorbed cost of keeping workers on the payroll during periods of idleness should not be charged to it. Taking this into consideration, the suggestion was made that any difference between the normal and actual labor cost in shifting skilled men should be carried in a special account for the whole plant as an additional index of idleness in periods of depression.

How should the Red Metal Manufacturing Company handle the charges for skilled labor shifted to other departments during periods of depression?

5. DRAYFUS MACHINE COMPANY AND THE KIRKLAND TURBINE COMPANY—COMPARISON OF LABOR RECORDS

The Drayfus Machine Company manufactured machines for several different industrial uses. The machines varied in size and complexity; and in selling value from $100 to $15,000. In the manufacturing department there were normally 1,200 employees, and 110 in the office and planning departments.

The Kirkland Turbine Company produced small steam turbines for industrial purposes varying in size from one to 1,200 horsepower. There were 240 employees in the shop and 16 in the office.

The methods of compiling labor costs and the forms used in the compilations are described below. The actual forms referred to have been condensed in Forms 15 to 29.

DRAYFUS MACHINE COMPANY

Payment of Wages. Wages were paid by piece-rate, premium-rate, and day-rate. Under the premium plan, the value of the time saved on a job was divided equally between the company and the men. For example, if a time was set at 12 hours and the man performed the job in 10 hours, he was paid for 11 hours. There was a tendency toward the elimination of the premium plan in favor of straight piece-work, because it was found that the men did not attempt to qualify for premiums. Every piece-

(Hours are shown in this column divided into 15 minute periods.)	Date	Department	Order Number
	Workman's Name		Number
	Day-Work		
	Time Limit	Actual Time	Rate Amount
	Piece-Work		
	Number of Pieces Started		Rate Amount
	Number of Pieces Finished		
	Date Started		Date Finished
	Operation		Number

Form 15: Bishop Time Card

worker and premium worker had a minimum day-rate which he was paid regardless of the amount of work he did. He also was paid at the day-rate for all time lost in case his machine broke down or work was not ready for him.

Overtime was paid for at an increased rate, and the cost of overtime was charged to expense and spread over the entire plant production as an element of burden.

KIRKLAND TURBINE COMPANY

Payment of Wages. Wages were paid on piece-rate and day-rate basis. Normally 28% of the total amount of wages was

Lot Number _____ **WORKS ORDER** (Foreman's Copy) Date Issued _____ Date Completed _____

Instructions	Number Pieces Received by Department	Date Received	Number Sent to Inspector	Number Passed Inspector	Number Scrapped		
					Machine	Cast	Time Lose
Material							
Pattern Number							
Specified Number							
Type							
Drawing Number							

Piece Number Name Date Wanted

Form 16: Foreman's Copy of Works Order

paid on piece-work. An additional rate was paid for overtime, but overtime was not allowed unless a man worked more than the scheduled number of hours per week.

DRAYFUS MACHINE COMPANY

Employees' Labor Records. Each man was furnished with a job card for each job on which he worked. This card was one of a series of three forms used as labor records:

Foreman's Board Card
Inspection and Move Card
Man's Job Card

These cards were printed so that each one showed the following information: man's name; man's number; allocation of charge; operation number; piece symbol; description of operation; standard or alternative machine to be used; machine location; instruction card number; finished or not finished; original number of pieces.

Special additional information was provided for on each of the three forms according to their use, as shown on the forms themselves. (See Forms 21, 22, and 23, pages 175, 176 and 177).

No time clocks were used; all labor was reported to cost department on job cards (see Form 23, page 177), issued from planning department, and returned to that department by man's shop bulletin clerk when the job was finished. The route clerk in the planning department placed the charge symbol on the

Turbine	File Number	Steam Pressure	Steam Heat	B. P.	Vac.
Sold to					
Customer's Order Number		Date			
To be used by					
Location					
Shipment promised		Made			
Type H. P. D. W. KVA.					
Speed					
To drive					
Service					
Unit assembled by					
Base furnished by					
Outline Print		Sent			
H. S. Coupling size and type					
L. S. Coupling size and type					
Case bored for		Jet			
Description governing mechanism					
Description gland system					
Remarks					
		Signed			
		Date			
Lot Number		Turbine Number			

Form 17: Assembly Sheet

card before it was issued. This symbol served to indicate to the cost department the exact allocation to be made of the charges which were accumulated on the card.

All job cards were made out in the planning department. They were distributed ordinarily each morning. At the entrance to the machine shop a rack was provided which could be closed and locked. Before work began for the day the clerk from the time department opened and placed in this rack the new job cards for the day. Each workman on arrival went to this rack, removed his job card, and proceeded with it to his machine. If he had not finished the job he had been working on the night before, he found in the card rack a new card which had been duplicated from the previous day's card and bearing exactly the same data.

The workmen deposited their cards in the rack when they went out at noon and removed them on their return after the lunch period. If a man was late, he found that the rack had been closed by the time clerk and that his card had been taken to the

Weekly Time Sheet From _____ To _____

Clock Number	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Total Piece-work
	D.W.	P.W.	D.W.	P.W.	D.W.	P.W.	D.W.	P.W.	D.W.	P.W.	D.W.	P.W.	
1													
2													
3													
4													
5													
6													

Form 18: Weekly Time Sheet

planning department. As this card was his authority to work, he went to the planning department where the card was given to him stamped "not on time," and with the time issued. If a man left the plant before closing time, he took his card to the planning department where a clerk rung it off at the time of leaving.

Production in the plant was controlled by a system of shop bulletin boards which indicated the jobs in process being done by each man, and also the next job to which each man was to be assigned. When a man finished a job, he took his job card to the clerk at his shop bulletin board. The clerk then informed him what new job to start on. The man's card for the job finished was sent by messenger to the planning department, where a clerk stamped the time finished on the job card and sent it to the cost department. Then he stamped the same time (after "issued") on the job card to be used for the next job called for by the shop bulletin board. The new card then was sent to the shop bulletin clerk with an inspection slip for the former job. The clerk delivered the new job card to the workman, and at the same time the clerk made a count of the number of pieces finished on the previous job and entered the count on the inspection slip. This was then returned to the planning department where it was used to notify the route sheet clerk that the job was ready to be moved to the next machine. From the route sheet clerk it was sent to the cost department as a check against the number of pieces previously reported on the man's job cards. Two or

more cards will have been accumulated in the cost department on the same job, if the man had worked on it for more than one day.

When a man set up his own machine in preparation for a new job, he sent to the planning department a slip calling for a Set-Up card. The planning department clerk accordingly made out

Accumulative Cost Record

Date Issued | Date Completed | Piece Number | Lot Number

Instructions:

	Material Used	Value	Material Used	Value	(etc.)

Operation Costs

	Operations—						Total	
	Week Ending	Time	Amount	Time	Amount	Time (etc.)	Time	Amount

Overhead Rate——— Summary (Material ——— (Labor ——— (Overhead ——— (Total ——— (Cost Each ———

(This summary appears on the other side of the sheet)

Form 19: Accumulative Cost Sheet

a Set-Up card (a form similar to Form 23, page 177 but with space for Set-Up time), stamped it, and returned it to the man. When the machine was ready, the Set-Up card was rung up and the job started. Setting-up time was returned by the cost department as part of the working time of the machine; but by the use of the Set-Up card the man was saved from the loss he would suffer if obliged to include the set-up time in his piece-rate earnings.

Material _____ Piece Number _____
Description _____ Types _____

Date	Order Number	Number of Pieces Ordered	Number O. K.	Hours	Overhead Rate	Overhead	Material	Labor	Total	Price Each

Form 20: Summary Cost Card

KIRKLAND TURBINE COMPANY

Employees' Labor Records. All labor was reported on Bishop time cards (see Form 15, page 170). These cards had spaces for: day; department; order number; man's name; man's number; day-work; time limit, actual time, rate, amount; piece-work; number of pieces started, finished, rate, amount; date started; finished; operation and operation number.

Each workman had a time card which he punched on a time

I have inspected the first _____ pieces on this lot and found them O.K.
Charge to _____
Signed by _____

Man's name _____ Man's number _____
Department _____

Operation number _____ Piece symbol _____ Lot number _____ Operation _____

Alternative machine	Standard machine	Location	Instruction card number	If not finished scratch this	F
				If finished scratch this	NF

Original number of pieces _____

Material	Data	Means	Started	Finished

Form 21: Shop Foreman's Board Card

clock, when entering or leaving the plant. The time clock cards were distinct from the Bishop time cards.

A timekeeper in the shop made out all the job cards, which were kept in a rack under the workman's number. When a man finished a job, he reported to the timekeeper, who punched the time finished on his Bishop card, and made out a new one for him. The necessary information for these new cards was ob-

Returned Issued			Charge to		
Man's name			Man's number Department		
Operation number		Piece symbol	Lot number Operation		
Alternative machine	Standard machine	Location	Instruction card Number	If not finished scratch this	F
				If finished scratch this	NF
Original number of pieces					
Number of pieces previously condemned		Number of pieces condemned this operation	Number of pieces finished this operation	Inspected by Signed	
Move to			Moved by Signed		
Route sheet		Inspection and move card	Location received by Signed		

Form 22: Inspection and Move Card

tained from one of three production forms issued by the planning department. The three types used were Foreman's Copy of Works Order (see Form 16, page 171), Job Tag, and Assembly Sheet (see Form 17, page 172). The foreman loaned the workman one of these three production orders to show him his next job, and to enable him to get a time card for it.

Each afternoon the timekeeper duplicated the card on which the man was working at the close of the day.

Each night all cards were taken from the rack and rung off with the finished amount. The rack then was refilled with the duplicate cards prepared for the next day's work.

If a man was late by less than three minutes in reporting for work in the morning and afternoon, no deduction from wages

was made. If he was more than 3 minutes late, his wages were docked 15 minutes.

DRAYFUS MACHINE COMPANY

Payroll Preparation. After the planning department clerk stamped the time finished on a man's job card, the card was submitted to the cost department where all job cards were sorted

Returned Issued					Charge to				
Man's name						Man's number		Department	
Operation number		Piece symbol		Lot number		Operation			
Alternative machine	Standard machine	Location		Instructions Card number		If not finished scratch this			F
						If finished scratch this			NF
Original number of pieces									
Number of pieces finished today		Machine				Man's time	Man's rate	Rate —— Per ——	
		Time	Cost number		Relative cost				
								Piece-rate earnings	
Route sheet	Pay roll	Man's cost	Machine cost		Man's job card				
								Day-work earnings	

Form 23: Man's Job Card

by clerks into racks corresponding to each man's number. All day-work wages were figured from a confidential file showing each man's rate. All piece-work wages were figured from the rate which was shown on the card itself. All day-work wages were entered at the end of the week on a Man's Weekly Statement (see Form 24, page 178).

All piece-work was entered similarly on a Man's Daily Piece-Work Statement each day. This form (see Form 25, page 179) provided for date, workman's name and number, order number, operation, pieces claimed each day, price per piece, earnings, total time on piece-work, time on day-work, total time worked,

Man's weekly statement — Month Day Year
Your time and earnings were as follows
For week ending

Workman's Name _____ Workman's Number _____

Day	Date	Time actually worked	Extra allowed for overtime	Total time to be paid for	Bonus and day-work
Mon.					
Tue.					
Wed.					
Thu.					
Fri.					
Sat.					
Sun.					

Total time for which you will be advanced at

per hour, and amount

Total amount credited this week

Form 24: Man's Weekly Statement

rate per hour, total piece-work earnings, day-work earnings, and total earnings each day (piece-work plus day-work).

One copy of this statement was returned to the man to prevent future disputes about wages. The other copy was sent to the paymaster for use in making out the payroll. It was returned by the paymaster to the cost department for the statistical records.

All piece-work reported was entered, as reported for each operation, on a Piece-Work Carry-Over Card (see Form 26, page 180) which collected all pieces finished on this particular lot as rapidly as they were reported.

When the job was finished, the total amount due the man was figured at the bottom of the slip, which was held until the special slip bearing the foreman's total count was received. The count on the inspection slip was taken as final, and the carry-over slip was adjusted, if there was any discrepancy.

KIRKLAND TURBINE COMPANY

Payroll Preparation. The timekeeper held all finished cards

Daily Piece-Work Statement				Month	Day	Year
Your time and earnings were as follows on						19
Workman's name _____			Workman's number _____		Department _____	
Order number	Operation		Pieces claimed this day	Price per piece	Earnings $	c
Total time on piece-work = A	Hours	Tenths	Rate per hour	Total piece-work earnings	C	
Time on day-work = B			R	Day-work earnings D = B + R	D	
Total time worked = A + B			Total earnings this day = C + D			
Signed _____ Time Clerk						

Form 25: Daily Piece-Work Statement

until the end of the week, and then turned in to the cost department all Bishop time cards, all time clock cards, and a weekly time sheet (see Form 18, page 173) on which he had entered each man's number and day-work hours, piece-work hours, and piece-work earnings for each day of the week. In the last column his piece-work hours and piece-work earnings for the week were totaled.

The cost department received the Bishop time cards and the time clock cards from the timekeeper. One clerk in the cost department checked the time clock cards against the Bishop time cards and then computed the payroll.

DRAYFUS MACHINE COMPANY

Cost Accounting for Labor and Burden. After the weekly statements had been made out for the payroll department, the job cards were re-sorted by job numbers. The machine-rate then was entered and the total amount of the machine-hour cost was

Piece-work Carry over card				Order number		
Original number of pieces in lot	Man's name		Man's number			Department
			Operation			Machine Number
Pieces claimed this day	Month	Day	Day of week	Time worked		Rate per piece = R
				Hours	Tenths	
						Amount earned C = AxR
						Amount earned per hour = C ÷ B
	A = Total number of pieces finished		Total time worked = B			
	Payroll	Cost sheet				

Form 26: Piece-Work Carry-Over Card

figured on the cards. The actual hours operated and the amount earned were entered from these cards on a Record of Machine Time. The latter sheet, therefore, showed the working time of the machines, and served as a basis for future readjustments of the machine-rate.

All factory burden was distributed directly to product through machine-rates. In departments where there were no machines, a uniform rate per employee was used. That rate was determined by dividing total number of employees in the department into the total department burden.

This completed the computation of the labor cost and amount of factory burden for each job. In the cost department the job cards were collected by job, assembly, and lot number, together with the stores issued slip for the same job. Stores issued slips showed the price at which material used on the job was billed by the stores department. All these cards on the same job were placed in a cost collecting tray behind a cost collecting card (see Form 28, page 182).

The cost collecting cards showed the destination of the cost charge, description of the part, and wages incurred on the job in each department by weekly periods for two months. At the end of each week the total of all labor, material, and machine costs for one job was entered on one of these cards.

Unit Cost Card

Piece Name							Piece Symbol		
Lot Number	Finished	Quantity	Material	Labor	Miscellaneous	Total	Lot Number	Finished	Etc.

Form 27: Unit Cost Card

KIRKLAND TURBINE COMPANY

Cost Accounting for Labor and Burden. A second clerk separated all cards into productive and nonproductive groupings. The productive group cards were arranged by departments and the nonproductive group cards by standing expense orders (overhead classification numbers) for each department. A third sorted all productive job cards according to job number, lot number, and operation. The results were posted on a cumulative cost sheet (see Form 19, page 174). A cumulative cost sheet was filled out for each lot number calling for production of a standard part or piece. On this sheet were shown the value of material used in completing the lot order and the weekly labor operation costs for each operation through which the parts were put. This made it possible to compile a total of labor and material costs for each job number and the unit cost. In determining the unit cost, no overhead was included.

All burden was spread over the product on the basis of productive wages. It was not departmentalized, except for statistical purposes, but was taken for the plant as a whole. Burden was divided under the general heads: (1) Selling Expense, covering salesmen's salaries and expenses, commissions, and advertising; (2) Administrative Expense, covering officers' salaries, general office expense, including supplies and stationery, all engineering and drafting room expense, and similar items; (3)

Description					Charge to		
Weekly period		Wages in DD	DM	DS	DT	For entire month		
Month of	1					Stores		
	2					Foundry delivery		
	3					Worked material		
	4					Miscell-aneous		
	5					Damage reports		
	6							
Totals								
Weekly* period		Wages in DD	DM	DS	DT	For entire month		
	1					Stores		
	2					Foundry delivery		
	3					Worked material		

Form 28: Cost Collecting Card. Note: Six weekly periods are provided for in each month, in case fractions of a week should occur at the beginning and end of the calendar month, this enables the weekly payroll periods to be reconciled with the cost records for calendar months.

Factory Expense, including (a) nonproductive labor and material on such items as installation of machinery, light, heat, and power, painting, and crating, storeroom labor, repairs to tools, crane labor, shop superintendence, shop maintenance, experimental work, idle time and instruction time, pattern maintenance, and miscellaneous shop labor; (b) nonproductive expense, such as insurance, depreciation, freight and express, and local taxes.

All burden was determined in the Accounting Department from figures furnished by the Cost Department. The estimated burden

COST SHEET	Description	Charge symbol

Date of order is Symbol and lot number Quantity finished on order Month in which work is done	STARTED FINISHED	STARTED FINISHED
	total	total
Department Machine hours x cost nos. in A B C D		
Wages in A B C **Total wages = A** D		
Shop expense in A B C **Total shop expense = F** D		
Total wages Operating expense **Total shop expense** Stores Foundry delivery Stock worked materials Miscellaneous		
Total manufacturing cost Damage reports **Net manufacturing cost** Unit cost		
Date of order is Symbol and lot number (Etc.)		

Form 29: Cost Sheet

ratios were given to the Cost Department to apply on the Assembly Cost Sheets and summary cost cards. Any burden adjustment required at the end of the year was charged to profit and loss.

DRAYFUS MACHINE COMPANY

Cost Summaries. When a job was finished, the cost collecting cards formed a summary of all costs on the part. The information on the cost collecting cards was transferred to the Cost Sheet (see Form 29, page 183). The Cost Sheet summarized for each complete job number, the materials, wages, applied machine costs, and shop expense. From these a unit cost per machine is computed.

The unit costs of the same type of machine varied slightly with the different job numbers. Because of the variation which occurred from one job number to another, an average of unit costs was found each six months. This average was the actual cost used per unit in the balance of stores ledger.

To determine the average, unit costs were collected on a Unit Cost Card (Form 27, page 181). On this card were entered the unit costs by job numbers of material, labor, and miscellaneous expense, as well as total unit cost.

The cost department made out a weekly Distribution Report, which showed the departmental distribution of wages and salaries in the factory. After having been checked against the payroll sheet, it was submitted to the general accounting department of the company where it was used, together with other reports, to make a monthly distribution of all factory costs. In this manner actual wages paid were included in the total summaries of factory costs. Distribution was made on a sheet which was so arranged that nonproductive labor was collected with other expense items for the estimation of overhead ratios.

KIRKLAND TURBINE COMPANY

Cost Summaries. Summary cost cards were kept under each piece number. These cards (see Form 20, page 175) showed the order numbers of successive jobs producing the particular piece, and listed for each job the number of pieces ordered, pieces o. k.'d, hours of direct labor, overhead rate, overhead, material, labor, total cost, and price each.

6. SENECA FLOUR MILLING COMPANY—LABOR COSTS

The Seneca Flour Milling Company employs 10 girls to pack its flour in bags ranging from 2 to 12 pounds. In order to keep these girls busy when there is no flour to be packed in the small-sized bags, the Seneca Company erected a small bag factory in which to manufacture some of the bags used.

The regular employees of the bag factory are paid a day wage of $2.25 plus a piece-rate on all work done above the task set, but the girls who pack flour are paid their usual day-wage of $2.60 plus the same piece-rate. In the cost records, the bag factory is charged $2.60 a day for the time used in making bags by the girls packing flour, plus the usual bonus paid the regular bag factory girls. The manager of the bag factory asserts that he should be charged for the extra help only at the same rate as he is charged for the regular employees. The superintendent of the mills, however, expressed the opinion that inasmuch as the bag factory takes the flour-packing girls as an accommodation, it should not pay anything for this additional help.

How should the labor costs of the bag factory be accounted for in the records of the Seneca Flour Milling Company?

7. THE DELIGHT FLOUR MILLS CORPORATION—COST OF MAINTAINING A CITY WAREHOUSE

The Delight Flour Mills Corporation of St. Paul delivers flour to retail stores in St. Paul and Minneapolis from its own city warehouse. In order to determine whether or not it should continue its present organization or employ the services of a wholesaler, the management is endeavoring to ascertain its own wholesaling costs in the Twin Cities.

The organization of the city sales department, which controls the operation of the city warehouse, is independent of the general sales department. The manager of the city sales department may ask for any kind of flour at any time for storage or for delivery. Three men, working from seven in the morning until four in the afternoon, have charge of the warehouse and assist in loading the company's trucks as well as loading the trucks of retailers. Separate costs which are kept for the city sales department include charges for rent for the space occupied by the selling organization and the warehouse. This charge is

merely a bookkeeping entry, but it is included in order that a true comparison may be made with the cost of employing the warehouse services of a wholesaler.

The packing and loading crews which work in three eight-hour shifts are kept as small as possible without causing delay during the rush periods. Because the time at which freight cars are available for loading is uncertain, the packing and loading crews usually deliver flour to the warehouse when there are no cars to be loaded. It happens therefore that most of the flour is delivered to the city warehouse at night.

If flour is available to be delivered to the warehouse during the day, it is dropped through a chute into the warehouse and the warehouse men pile it. If the flour is delivered when the warehouse men are off duty, a packing and loading crew piles it. For this service, the packing and loading department receives a credit based on the per barrel rate for loading flour into freight cars, and the city warehouse is charged accordingly.

The head of the city sales department objects to being charged for piling flour delivered to the warehouse at night because if deliveries were made during the day his own men could handle it. Furthermore, if warehouse service were arranged with a wholesaler, deliveries would have to be made in the daytime.

Should the city warehouse or the mill bear the charges for piling flour delivered at night?

8. STOCKBRIDGE SMALL ARMS COMPANY— AUDITING PAYROLL COSTS ON COST-PLUS CONTRACT

In March, 1918, the Stockbridge Small Arms Company entered into a contract with the United States Government for the manufacture of a machine gun which necessitated the addition of a new plant to be built in Stockbridge. This contract called for payment by the Government for the expenses of erecting the plant. The Stockbridge Company, with the approval of the Government, placed the order for the construction of the buildings with the Platt and Drew Construction Company of New York. In order to make sure that the true costs of the building should be ascertained for payment, the auditor of the Stockbridge Company drew up a method of procedure to be followed by and between the Platt and Drew Construction Company

(hereinafter called the Construction Company), and the Stockbridge Small Arms Company (hereinafter called the Superintendent), and the United States Government (hereinafter called the Owner).

In the outline drawn up by the auditor the following methods for handling payroll and the accounting in connection therewith were included:

Payroll Division

Rate Card

(a) The Construction Company should provide adequate facilities for the employing of labor. This department should be known as the Employment Bureau, where in addition to the employing of labor, the rate card should be rendered in all its details; identification badges should be in its charge, and it should also be the medium through which all terminated men should pass prior to their termination being accepted. The responsibility for identification badges should be established, and it should conform to the requirements of the Superintendent in its custody and distribution of the badges.

(b) The Rate Card should be rendered complete by the Employment Bureau, which should each day forward such completed rate cards to the payroll division for the purpose of having time cards prepared as well as the recording of employees' payroll, and so forth, and the posting of rates upon the payroll. It shall be understood that all labor rates and changes thereto shall at all times be subject to the inspection, and if necessary the approval, of the Superintendent. The procedure for rate changes will be that of rendering a form in duplicate, by the representative of the Construction Company, which form, in duplicate, shall, if required, be submitted in turn to the Resident Engineer of the Superintendent and the Owner for approval.

Time Card

(a) It is required that a separate Time Card be rendered by each employee daily. The cards should be prepared in the Payroll Division and placed conveniently so that an employee may be able to obtain his Time Card at the time of entering the plant upon his shift of work.

(b) It will be required that the employee have his Time Card punched upon a time clock at the time of entering—also at the time of leaving—in order to enable the Payroll Division to place the correct amount of time upon the payroll sheets.

(c) It will be required that employees make distribution of their time according to job numbers upon the face of Time Card in the form prescribed. In this connection, the Construction Company should maintain an adequate force throughout the plant to facilitate obtaining correct distribution of time.

(d) Upon the day that new employees commence working they

should obtain a Time Card for that day from the Employment Bureau, which should insert the name and punch thereon the time of starting.

PAYROLL FORM

(a) Payrolls should be prepared in the original copy only, and if the Construction Company requires additional copies it should make arrangements to make transcription after the original copy has served its purpose. The Construction Company should arrange to have all names and check numbers of employees inserted upon the payroll by "Addressograph," or other similar equipment, and should provide the payroll sheets in proper time for the posting of the current week's labor.

(b) The Construction Company should provide for employees terminating and paying them within a pay period. Such disbursement should be entered in the "advance payment" column provided therefor.

(c) The Construction Company should utilize this payroll form for the purpose of obtaining evidence of payment of wages upon each pay day.

(d) The procedure of paying wages upon regular pay days will be as follows:

1. There shall be present:
   a. A representative of the Construction Company Treasury Department, whose duty it will be to disburse the wages.
   b. A representative of the Superintendent to verify disbursements, and to place his stamp of approval upon payroll sheets containing the names of employees and the amounts being disbursed under his inspection.
   c. A representative of the Construction Company to check disbursements and likewise to place his stamp of approval in the manner prescribed for the representative of the Superintendent.
   d. A representative of the Construction Company to identify the employees and to assist in the placing of employees in their numerical order to expedite disbursements.

2. Wages so disbursed shall be paid at other than working hours if possible.

3. Each employee as he presents himself to receive his wages should be required to call his name and to show his badge.

4. The various representatives specified in 1-a, 1-b, and 1-c should compare the name and number called by the employee with that contained upon the pay envelope prior to its being given to the employee.

TERMINATION NOTICE

This form need be rendered only in a single copy, and should be prepared by respective foremen. The following process should be followed:

(a) Foreman prepares Termination Notice.

(b) Delivers termination notice to employee, who should proceed to the Tool Room to obtain "Tool Clearance," or in absence of "Tool Clearance," the Tool Room representative may insert upon Termination Notice the value of tools not returned, and then the terminated employee should proceed with his Termination Notice to the Employment Bureau.

(c) The Employment Bureau should relieve the employee of his Termination Notice and badge, and give him in its stead an Identification Slip which authorizes the employee, upon a prescribed day and hour to present such Identification Slip at the Cashier's Office, where, after he has endorsed said Identification Slip, he will receive in exchange therefor the wages due him.

(d) Promptly upon receipt of Termination Notice, the Employment Bureau should forward such notices at prescribed times during the day to the Payroll Division, where calculations will be made of the earnings due the respective terminated employees. Each day the Payroll Division should prepare a Payroll Statement, showing name and number of employees and amount of wages to be paid, together with pay envelopes prepared in the same manner as the Payroll Sheet, all of which should be forwarded to the Cashier's Office in ample time for the assembling of such wages, and their disbursement at such hours as may be required.

(e) The Payroll Division should retain the Termination Notice as its authority for entry upon the Payroll Sheet in the "advanced payment column," and at the conclusion of each payroll period should prepare a summarized statement of such Termination Notices in order to verify the amounts so entered upon the Payroll Sheets in total.

(f) All disbursements of such wages should be entered in the Petty Cash Book of each pay period separately, in order that the process of auditing payroll disbursements by pay periods may be simplified.

General

Payroll Distribution

(a) This record should be provided in one copy, and is for the purpose of making distribution of labor to the job numbers as assigned. Separate distributions will be provided for separate sections or trades of labor as provided under payrolls, so that sectionalizing of payrolls may be obtained, and thus simplify accuracy of labor distribution.

(b) Separate sheets should be provided for each job or order number for each payroll section. The process will be that of accumulating hours only, either daily or as frequently as the Superintendent's representative may find it necessary. The total hours of distribution should be checked and made to agree with the payroll hours, but any irregularity should be adjusted promptly. The average rate of labor should be employed in distributing the value of labor. This distribution should be balanced monthly with the amount credited to Accrued

Wages, and the distribution should be journalized to the respective job or expense account numbers, in the form prescribed by the Superintendent.

9. THE SEABRIGHT MILLS—METHOD OF ACCOUNTING FOR TENEMENT COSTS

The practice of the Seabright Mills in handling tenement costs has been to charge the excess of expenditures over receipts for rentals to repairs and maintenance, which are distributed to the mill-operating departments on a basis of space occupied. Since only a nominal rental is charged, the total so distributed amounts to a considerable sum. As the company is enabled not only to keep its labor contented by providing modern attractive living places, but also to maintain a somewhat lower wage rate because of the lower rentals charged, the treasurer asserts that these tenement costs should be charged to labor.

It is because a large part of the expenses incurred for tenements are for repairs and maintenance, most of which are done by the mill repair men, that the accountant has charged them to the repairs and maintenance accounts. He opposes a change because it would introduce a variable element in the labor costs of the mill. The directors authorize extensive repairs periodically, chiefly when labor shortage necessitates making special efforts to keep employees, so repairs and maintenance of tenements are likely to be heavy at certain periods and light at others. Such expenses incurred in a single three months' period would disturb the total of labor charges which otherwise would vary only slightly. Moreover, since the overhead charges are distributed to the product of the operating departments on the basis of labor charges, the costs of the 16 styles of cloth would be disarranged, and the estimation of costs on the basis of past percentages would be made difficult. The accountant maintains, moreover, that it would be impossible to allocate such tenement charges to a definite period, because the benefits of the expenditures do not materialize immediately in a tangible form. They are received in a lower wage scale, the contentment of labor, the absence of strikes and labor troubles, and reduced labor turnover.

How should these tenement charges be accounted for?

REFERENCES

AFFELDER, WILLIAM M. "Principles and Practice of Construction Costkeeping," *N. A. C. A. Official Publications*, Vol. III, No. 22.

BERNSTEIN, P. "Establishing Standards in Time Study," *Industrial Management*, Oct., 1922, pp. 243-249.

BOBER, W. C. "Chart of Labor Routine," *N. A. C. A. Bulletin No. 33*, Aug. 15, 1922, pp. 342-343.

BRIGGS, W. "Wages and Timekeeping," *The Cost Accountant*, Jan., 1923, pp. 277-278.

CALL, H. A. "Analysis of Construction Costs and Methods," *Sanitary and Heating Engineering*. Fourteen articles running from April 8, 1921, to April 7, 1922.

CONNOR, W. N. "Construction Costs," *Journal of the Boston Society of Civil Engineers*, May, 1921, Vol. viii, No. 5, pp. 160-177.

DARK, S. J. "Labor," *Business Organization and Management*, Aug., 1920, pp. 475-482.

DARNELL, R. W. "The Relation of Time Study to Cost Accounting," *Industrial Management*, Nov., 1922, pp. 272-378; Dec., 1922, pp. 341-345.

GANTT, H. L. *Work, Wages and Profits*. The Engineering Magazine Co., 1919.

GILLETTE, H. P. and DANA, R. T. *Construction Cost Keeping and Management*, pp. 64-109, 127-339. McGraw-Hill Book Co., New York, 1916.

GRANT, H. D. *Practical Accounting for General Contractors*. McGraw-Hill Book Co., New York, 1922.

HIGGINS, C. "Simple and Accurate Method of Keeping Labor Cost Records," *Electrical Record*, Jan., 1923, pp. 17-21.

KUELLING, H. G. "Cost Analysis of Day Labor Construction of Wisconsin Concrete Roads," *Concrete*, Feb., 1922, pp. 81-86.

LICHTNER, W. O. "Labor Relations and the Stop Watch," *Industrial Management*, July, 1922, p. 31.

NISBET, A. G. "Terminal Cost Accounts," *Accountants Library*, Vol. xlvi. Gee & Co., London, England, 1906.

PATERSON, J. H. "A Premium Incentive Wage Plan," *N. A. C. A. Official Publications*, Vol. III, No. 13.

POROSKY, MATTHEW. "A Method of Distributing Factory Payroll," *N. A. C. A. Official Publications*, Vol. II, No. 16.

VON HUHN, R. "Wage Analysis," *Management Engineering*, Nov., 1922, pp. 307-310.

——— "A Labor Performance Sheet That Serves a Fourfold Purpose," *Factory*, Sept., 1922, pp. 251-252.

——— "The Effect of Rate Setting on Labor Costs," *Industrial Management*, July, 1922, pp. 169-172.

——— "Wages of New Workers," *N. A. C. A. Bulletin No. 30*, July 1, 1922, pp. 293-294.

IV

BURDEN—ACCUMULATION AND DISTRIBUTION

1. THE SANTRY MILLS—DISTRIBUTION OF BURDEN

THE treasurer of the Santry Mills recently received a bulletin from a cotton manufacturers' association describing and recommending a textile cost accounting system. The differences between the method of distributing burden outlined in the bulletin and the method used in the mill brought up the question of whether a change should be made in the latter to conform with the former.

Several representative methods of distributing burden are described in the bulletin as follows:

All Costs Grouped and Charged per Pound of Product

Some mills, at the end of each period, group total net expenditures for cotton used, labor, supplies, salaries, general expenses, and the like, into one grand total. This total is then divided by the pounds of cloth woven (all styles together). This gives them an average cost per pound on all styles. By dividing this by the yards per pound for each style, these mills get what they term the "cost per yard."

That such results are inaccurate becomes evident if one divides the weaving price per cut for each style by the weight of the cut. Most of these mills also pay piece-rates on their fly frames, and one can demonstrate again that the cost is not uniform per pound by calculating the cost of piece-work per pound of roving.

Overhead Charged Uniformly per Pound of Cloth

Some Treasurers contend that it is not necessary to divide the overhead between the weave room and the various yarn departments to get accurate costs by fabrics. They frequently argue that since they sell only cloth, all these charges must be borne by the cloth eventually so that it does not matter how they are distributed so long as the correct total is included. Therefore, after carefully analyzing their labor costs, they revert to the method of averaging the overhead per pound of cloth.

A careful study of the problem, however, shows that it is just as important to correctly distribute the burden as it is to charge each style with its own weaving piece-work cost. The overhead charges in a mill using simple looms will have as much bearing upon the cost

of the fabrics as the price of weaving. When the mill is equipped with automatic looms, the overhead charges on cloth are often over twice as great as weaving piece-work. Any cost system which fails to make each fabric bear its proper share of the overhead is sure to be misleading.

Overhead Charged Uniformly per Spindle

Not a few mills charge all the overhead to the yarn department and assume that it is uniform per spinning spindle, and therefore is greater per pound on fine numbers because of the lower production.

While this method is an improvement over those previously described, it leaves much to be desired, because a careful analysis of the items which make up the overhead shows that between 35% and 50% of them are caused by the mill owning and operating a weaving department, and that they would not obtain in a yarn mill. The results of this method are that the costs of high pick goods and of goods woven on narrow looms are figured too low, and the costs of wider cloth and of low pick goods, such as warp sateens, are figured much too high.

Overhead Charged Uniformly per Loom

Still another method which has a great many advocates charges all the overhead items to the weave room, and assumes that they are uniform per loom regardless of the style of cloth being run. It happens, however, that between 50%-65% of these charges are due to the yarn departments, and would not obtain if, as in England, the weaving mill should purchase its yarn. That these charges due to the yarn departments are not uniform per loom is quite evident when we consider that it is possible for two looms to use the same counts of warp and filling and yet produce 25 pounds per loom-week on one style and between 50 and 60 pounds per loom-week on another style. In one case it would be necessary to have over twice as much carding and spinning equipment to supply a loom as would be required in the other. Under this method errors of several cents per pound may occur in the relative cost of fabrics.

Assuming the Mill to Be Running One Style

One favorite method of attempting to apportion the fixed charges to the various styles is to assume that they are the same per pound on any style as they would be if the whole mill were put on to that style.

At first thought this may seem like a reasonable assumption, because if any style would throw the mill out of balance and cause idle equipment in certain departments, that style would, by this method of figuring, be penalized with the general expenses chargeable to the idle machinery.

For example, if a mill which is equipped with enough spinning to produce 40 pounds of yarn per loom-week should make filling sateen, which produced 25 pounds per loom-week, this style would be penal-

ized because the looms could not take care of all the yarn and it would be necessary to shut down part of the spinning. On the other hand, if this mill should make a poplin which produces 55 pounds per loom-week, this style also would be penalized because the mill could not produce enough yarn and it would become necessary to shut down looms.

If either of these assumptions should be carried out, the costs estimated by this method would actually obtain, but the fallacy of this system is very evident when we consider that the mill will probably never put all the looms on any one style. It is possible to have the mill perfectly balanced when half of the looms are on each of the above styles, although either of them alone would throw the equipment seriously out of balance.

Overhead as a Percentage on Direct Labor

Another way to distribute overhead is as a percentage of direct labor. This method has quite a few defenders and books have been written in past years advocating it. The method is easy to use, but is inaccurate and misleading for textile mills. A little reflection on the part of any mill man will convince him that there is no uniform relation between the labor cost in each department and the value of the machinery in that department or the power it requires. Both of these items affect that share of overhead which should be charged to a department.

Just how far an average percentage for overhead distribution on the basis of direct labor may depart from the truth may best be shown by the following study based on several mills which have accurate cost records and a proper division of overhead between departments.

By dividing the total overhead by the total direct labor in these mills, we find that the overhead proves to be about 78% of the direct labor. After apportioning the overhead to each department upon an equitable basis, and then dividing each department's share by the direct labor in that department, we have the following results:

Processes through Drawing,	Overhead was	172%	of Direct Labor
Roving Frames,	Overhead was	84%	of Direct Labor
Spinning,	Overhead was	134%	of Direct Labor
Spooling and Warping,	Overhead was	24%	of Direct Labor
Dressing,	Overhead was	93%	of Direct Labor
Weaving,	Overhead was	44%	of Direct Labor
Cloth Room,	Overhead was	68%	of Direct Labor

The Santry Mills divided burden into five groups, each of which was distributed quarterly, as shown in the report on the next page.

Distribution of Overhead—First Quarter

Department	Group I	Group II	Group III	Group IV	Group V	Total	Mill Labor	Percentage of Department Overhead
							(20.62)	
Picking and Carding	$ 5,457.48	$18,107.16	$ 8,216.01	$ 4,802.55	$ 1,594.73	$ 38,177.93	$ 44,976.20	84.88
							(26.22)	
Spinning	6,939.63	18,236.31	17,897.79	7,099.49	4,556.79	54,730.01	57,162.35	95.75
							(7.14)	
Spooling and Warping	1,889.74	2,460.35	617.16	443.38	269.02	5,679.65	15,571.65	36.47
			1,220.00				(3.59)	
Dressing and Drawing-in	950.16	1,362.56	385.73	801.11	343.67	5,063.23	7,848.15	64.51
							(38.92)	
Weaving	10,300.94	23,260.32	10,414.67	5,616.56	9,075.73	58,668.22	84,875.45	69.12
							(3.51)	
Cloth Room	928.99	1,149.45	1,041.47	603.35	194.10	3,917.36	7,656.40	51.16
Total	$26,466.94	$64,576.15	$39,792.83	$19,366.44	$16,034.04	$166,236.40	$218,090.20	76.22
Sizing Material					9,945.53	9,945.53		
Packing Material					2,883.69	2,883.69		
Total					$28,863.26	$179,065.62		
General Expense	$16,966.86							
Administration Expense	9,500.08							
	$26,466.94							
Interest		$14,076.15						
Taxes		20,000.00						
Insurance		5,500.00						
Depreciation		25,000.00						
		$64,576.15						
Power			$39,792.83					
Repairs				$19,366.44				
Supplies					$28,863.26			
		Overhead Charges		$ 179,065.62				
		Mill Labor		218,090.20				
		Cotton		594,118.06				
		Selling Expense		26,381.24				
				$1,017,655.12				

BASES OF DISTRIBUTION

Group I	Divided proportionately to Payroll	
II	Divided proportionately to	Value of space occupied Value of machinery and equipment
III	Divided proportionately to Power used *	
IV	Divided proportionately to	Space occupied Direct Power (See Power account on page 198)
V	Direct	

* POWER CHARGES FOR THE QUARTER

Slashers, 13 @ 15 Boiler h. p.	195 h. p.
Deduct for driving 1% of 7,260	73
	122 h. p.
122 h. p. at $50 per h. p.	4) $6,100 yearly
	$1,525 quarterly
Electric power charges (Power %)	$26,560.94
Steam for slashers (Charged direct to Dressing Yarn)	1,525.00
Balance of charges (Space %)	11,706.89
	$39,792.83

The following are the percentages used in distributing the burden to departments:

Department	Payroll Per Cent	Power Per Cent	Value of Space and Machinery
Picking and Carding	20.62	23.10	24.10
Spinning	26.22	50.10	27.60
Spooling and Warping	7.14	1.30	5.30
Dressing and Drawing-in	3.59	.80	2.70
Weaving	38.92	24.10	37.20
Cloth Room	3.51	.60	3.10
	100.00	100.00	100.00

The Administration Account included expense of maintaining the treasurer's office in Boston, and the administrative salaries of the mill. The other general burden accounts, Power, Repairs, and Supplies included the subsidiary accounts for one quarter as shown in the schedules on pages 197, 198, 199, and 200.

GENERAL EXPENSE
Quarter Ending March 31, 1917

Subsidiary Account	Payroll	Total All Charges	Group Totals
A. *Accounting*			
1. Salaries	$ 2,008.25	$ 2,008.25	
2. Supplies		407.24	
3. Equipment			
4. Telephone, Telegraph, Postage and Express		331.12	
5. Miscellaneous	123.50	188.94	$ 2,935.55
B. *Transportation*			
1. Cotton	2,127.75	2,355.75	
2. Cloth	822.55	1,034.95	
3. Yarn	28.20	28.20	
4. Stores	734.85	815.25	
5. Motor Trucks and Stable		512.44	4,746.59
C. *General Mill*			
1. Superintendents	1,900.08	1,900.08	
2. Watchmen	2,394.45	2,394.45	
3. Yard Gang	763.80	779.69	
4. Miscellaneous			
5. Storeroom	310.90	311.27	
6. Waste Handling	185.90	286.83	5,672.32
D. *Miscellaneous*			
1. Traveling Expenses		227.90	
2. Expenses	26.95	252.44	
3. Donations			
4. Accident Payments		4.00	
5. Securing Help		41.63	
6. Miscellaneous		245.68	
7. Project A	236.20	942.69	1,714.34
	$11,663.38	$15,068.80	$15,068.80
Miscellaneous charges not listed			1,898.06
			$16,966.86

ACCOUNT NUMBER 8—POWER
Quarter Ending March 31, 1917

Subsidiary Account	Payroll	Total All Charges	Group Totals
A. *Water*			
1. Labor, Cleaning Racks, Wheels	$ 425.05	$ 425.05	
2. Operating Supplies		74.93	
3. Purchases			$ 499.98
B. *Electric*			
1. Supplies (Lamps and Repairs not included		$ 24.05	
2. Purchases		26,560.94	26,584.99
C. *Steam Plant*			
1. Labor			
a. Boilers and Firemen	770.55	$ 770.55	
b. Coal Handling	573.40	573.40	
c. Ashes	82.60	82.60	
d. Engineer	925.35	925.35	
e. Expert Advice			
f. Compressors, Operation	383.85	383.85	
2. Operating Supplies			
a. Lubricants		5.00	
b. Other Supplies		123.06	
3. Fuel		10,751.54	
		$13,615.35	
Credit Power Company *		1,867.32	11,748.03
D. *Heating*			
1. Labor			
a. Number 5 Mill	343.20	$ 343.20	
b. Number 6 Mill			
2. Fuel			
a. Number 5 Mill		266.13	
b. Number 6 Mill		350.50	959.83
	$3,504.00		$39,792.83

* A-1 = $ 398.51
C-1 = 259.20
C-3 = 1,209.61
$1,867.32

Account Number 1—Repairs and Maintenance
Quarter Ending March 31, 1917

Subsidiary Account	Payroll	Stores	Total All Charges	Group Totals
A. *Buildings (Space %)*				
1. Mills	$1,386.45	973.56	$ 2,361.26	
2. Power House	10.45	.75	11.20	
3. Storehouse		69.11	69.83	
4. Miscellaneous	74.55	61.99	136.85	$ 2,579.14
B. *Mill Machinery (Direct %)*				
1. Picking	459.30	357.22	816.52	
2. Cards	186.65	191.80	378.45	
3. Roving		237.13	237.13	
4. Spinning	156.25	565.97	722.22	
5. Spoolers	32.45	4.26	36.71	
6. Warpers	7.45	10.81	18.26	
7. Slashers	223.30	272.59	495.89	
8. Drawing-in Machinery		86.20	86.20	
9. Looms	158.05	928.36	1,086.41	
10. Cloth Room	45.05	129.31	174.36	4,052.15
C. *Mill Equipment (Space %)*				
1. Sprinklers	95.75	30.39	126.14	
2. Fire Protection Appliance	46.75	96.87	144.39	
3. Elevators	43.00	29.24	72.24	
4. Plumbing and Sewerage	176.20	6.78	182.98	
5. Hydrants, etc.	243.75	9.08	252.83	
6. Humidifiers	53.90	3.65	57.55	
7. Signal Systems	31.80	8.60	40.40	
8. Shop Machinery	19.85	117.69	138.04	
9. Air Clean System	12.65	177.96	190.61	
10. Motor Trucks, Teams	511.85	* 8,040.93	2,560.71	
11. General (undivisible)	177.15	52.68	3,594.81 cr.	
12. Room Equipment	191.70		191.70	362.78
D. *Transmission (Power %)*				
1. Extraordinary Rep.	422.35	86.45	510.55	
2. Water Wheels, Racks	129.25	16.74 cr.	112.51	
3. Motors	573.25	1,078.45	1,690.51	
4. Generators	48.65	18.61	67.52	
5. Power House Machinery	134.55	1,054.50	1,191.32	
6. Heating System	225.15	121.97	347.27	
7. Lights, Wire, Transmission	131.05	613.62	744.67	
8. Shafting	675.80	5,764.83	6,620.93	
9. Main Belt Drive	93.00	6.23	99.23	
10. Main Rope Drive	52.80	1.66	54.46	11,438.97
E. *Supervision (Space %)*				
1. Draughting	504.40		504.40	
2. Master Mechanic	429.00		429.00	933.40
	$7,763.55	$21,192.51	$19,366.44	$19,366.44

* Inventoried $6,000.

ACCOUNT NUMBER 5, SUMMARIZED—MILL SUPPLIES
Quarter Ending March 31, 1917

Picking and Carding		
Room Supplies	$ 358.00	
Packing Material	9.62	
Machinery Parts	14.21	
Belting	263.16	
Card Clothing	309.63	
Covering Rolls	215.62	
Skewers	2.48	
Banding	79.44	
Lubricants	261.51	
Miscellaneous	81.06	$ 1,594.73
Spinning		
Room Supplies	$ 288.85	
Broomless Sweepers	950.00	
Filling Boxes	494.24	
Machinery Parts	198.78	
Belting	408.10	
Covering Rolls	1,865.75	
Travelers	111.46	
Lubricants	225.73	
Miscellaneous	13.88	4,556.79
Spooling and Warping		
Room Supplies	$ 155.53	
Belting	48.46	
Bobbins	25.00	
Knotter Parts	24.26	
Lubricants	11.42	
Miscellaneous	4.35	269.02
Dressing and Drawing-in		
Room Supplies	$ 104.92	
Belting	30.58	
Slasher Cloth	141.13	
Sizing Materials	9,945.53	
Lubricants	4.00	
Miscellaneous	63.04	10,289.20
Weaving		
Room Supplies	$ 211.58	
Machinery Parts	3,428.50	
Belting	1,151.31	
Shuttles and Parts	1,085.57	

Reeds	$ 1.85	
Harnesses (Heddles Included)	1,823.90	
Loom Strapping	506.59	
Temple Parts	293.06	
Picker Sticks	58.23	
Pickers	197.25	
Lubricants	273.21	
Miscellaneous	44.68	$ 9,075.73
Cloth Room		
Room Supplies	$ 133.45	
Oil Remover	56.84	
Machinery Supplies	3.81	
Packing Materials	2,883.69	3,077.79
		$28,863.26

The bulletin advocated for grey cloth mills, such as the Santry Mills, a more detailed separation of the constituent parts of burden shown in the table on page 202.

In the Santry Mills, all insurance charges were grouped and distributed on the basis of value of space occupied by departments. According to the new method Liability and Group Insurance, amounting to about $1,500 per quarter, would be distributed as a percentage of payroll, and Boiler and Fly-Wheel Insurance, amounting to $500 per quarter, would be charged on the basis of power. The mill treasurer, however, believed that this would be complicating the accounting without making an appreciable difference in the cost of the various styles of cloth. Although the distribution of Liability and Group Insurance on the basis of direct labor probably would be more accurate than on the basis of value of space, labor percentages in the various processes differed from the value of space and equipment percentages only slightly, as shown in the table on page 196. Spinning, for instance, had a value of building and equipment about equal to that of the carding department, and its direct labor was about the same as in the drawing department. On the other hand, charging Boiler and Fly-Wheel Insurance on the basis of value of space would make little difference in the portion borne by these two departments, since the percentages of value of space were approximately equal to the percentages of total power consumed.

If the recommended system were adopted, Office and Executive Salaries would be charged chiefly into Miscellaneous Expense

DISTRIBUTION OF OVERHEAD

Typical Items	Basis of Distribution
Property Taxes	Value of Land, Buildings and Machinery
Interest on Plant and Equipment	Value of Land, Buildings and Machinery
Depreciation	Value of Buildings and Machinery
Fire Insurance	Value of Buildings and Machinery
Liability Insurance	Amount of Payroll
Group Insurance	Amount of Payroll
Boiler Insurance	Power Consumption
Fly-Wheel Insurance	Power Consumption
Fuel and Purchased Power	Power Consumption
General Supplies	Records of Supply Consumption *
Repairs	Records of Repair Work Done *
Office and Executive Salaries	May be subdivided between material expense, selling expense, and miscellaneous expense
Capital Stock Tax	Value of Land, Buildings, and Machinery
Interest on Cotton	Material Expense
Interest on Cloth	Selling Expense
Interest on Supplies	Records of Supply Consumption *
Interest on Stock in Process	Value of Stock in Process
Interest on Cash	Miscellaneous Expense
Licenses, Donations, etc.	Miscellaneous Expense
Legal Expenses	Miscellaneous Expense
Use and Occupancy Insurance	Miscellaneous Expense
Office Expenses	May be subdivided between material expense, selling expense, and miscellaneous expense
Power Charges	Redistributed on Power Consumption Basis
Repair Shop Charges	Records of Repair Work Done *
Material Expense	Applied directly to raw material cost
Miscellaneous Expense	Applied as a machine charge at the limiting dept. (usually spinning)
Brokerage and Commission	Deducted from selling price
Other Selling Expense	Applied directly to the product

* Where records are not available, recourse must be had to local knowledge of conditions and experience in the treatment of this feature in other similar plants.

and distributed to the product as a machine charge at the limiting department (usually spinning). In the opinion of the mill treasurer, however, the amount of administration and paper work required at the mill was proportional to the labor costs. Since each department incurred charges for administration, an artificial condition would be created without contributing to correct costs if all these charges were allocated to the spinning department.

In the past the Santry Mills had charged interest only on borrowed money and had distributed it on the basis of the value of buildings, machinery, and equipment. The treasurer, however, was inclined to believe that the product should bear a charge for interest on owned capital as advocated by the recommended system, since, unless this was done, interest charges incurred in each quarter might vary to such an extent that costs would not be comparable. Money invested in the business furthermore should yield an income equal to what it would yield outside the business.

Material expense, which was charged into general overhead, would be applied directly to materials handled under the proposed system. Although this would reflect conditions more accurately than according to payroll, the treasurer asserted that, since these charges, which amounted to about $1,000 a quarter, were incurred in all departments in about the same proportion as under the payroll division in use, nothing would be gained by making the change.

The same was true of Miscellaneous Charges as of Office and Executive Salaries; the application to any particular department could not be as equitable, according to the treasurer, as a method which distributed them over all.

Should the Santry Mills have adopted the suggested method of distributing burden?

If not, what changes should have been made in the method used by the Santry Mills?

2. THE WHITE KNITTING COMPANY—DISTRIBUTION OF BURDEN

The system of accounting used by the White Knitting Company, manufacturer of glove cloth and sweaters, made no charges to operating departments for burden. Since the market for each of its two products had been severely depressed, it had become necessary to secure more accurate costs.

The following accounts were kept:

1. Cotton

Inventory	Wt.	Cost
A. Comber	...	...
B. Clip	...	...
C. Cotton	...	...
Purchases		
A. Comber	...	...
B. Clip	...	...
C. Cotton	...	...

6. Cotton yarn mill (Transfers to Process)		
Inventory	Wt.	Cost
A. Comber	...	...
B. Clip	...	...
C. Cotton	...	...

2. Dye

Inventory	8. Sweater cloth (Lb. basis)
A. Colored dyes	7. Glove cloth (Lb. basis)
B. Black dyes	
Purchases	Inventory
A. Colored dyes	A. Colored dyes
B. Black dyes	B. Black dyes
Labor (Payroll analysis)	

3. Packing Cases

Inventory	9. Sweater coats in process
	7. Glove cloth
Purchases	Inventory

4. Trimmings

Inventory	9. Sweater coats in process
Purchases	Inventory

5. Cardboard Boxes

Inventory	9. Sweater coats in process
Purchases	Inventory

6. Cotton Yarn Mill

Inventory	7. Glove cloth
1. Cotton	8. Sweater cloth
Labor (Payroll analysis) A. Garnetting B. Carding C. Drawing D. Spinning	Inventory

7. Glove Cloth

Inventory	
6. Cotton yarn mill	Cost of sales
Labor (Payroll analysis) A. Knitting B. Brushing C. Dyeing	Inventory
2. Dyes	
3. Cases	

8. Sweater Cloth

Inventory	
6. Cotton yarn mill	9. Sweater coats in process
Labor A. Knitting B. Dyeing	Inventory
2. Dyes	

9. Sweater Coats in Process

Inventory	
8. Sweater cloth	10. Sweater coats finished
Labor	Inventory
A. Tailoring	
B. Cutting	
C. Finishing	
D. Folding	
3. Packing cases	
4. Trimmings	
5. Cardboard boxes	

10. Sweater Coats Finished

Inventory	Cost of sales
9. Sweater coats in process	Inventory

The main divisions of the operations in the mill were indicated by the accounts. In the yarn mill the raw material consisted of cotton and two kinds of waste; one was known as comber, which was the waste resulting in cotton spinning mills when yarn was combed; and the other was known as clip, which was composed of clippings from underwear or hosiery mills. The yarn designed for the glove cloth was knitted and the nap of the resulting cloth was brushed. Then after being dyed it was ready for shipment to glove manufacturers. The yarn used for sweaters also was knitted into cloth which was cut up, tailored, finished, and packed in cardboard boxes ready for shipment. In all departments as much of the labor as possible was on a piece-rate basis and consequently the direct-labor cost per pound of product could be determined. Physical inventories were taken monthly in each department. In the operating departments a standard percentage was added to the value of the raw material on a pound basis for the labor which had been expended on it. No addition, however, was made for burden.

In order to arrive at cost figures for both sweaters and glove

MONTHLY OPERATING STATEMENT

Opening Inventory		$1,037,700	
Operating Account			
Cotton	$35,200		
Cotton Comber	50		
Mill Clip	4,800		
Dye House	8,300		
Trimmings	800		
Boxes and Cases	2,100		
Total	$51,250		
Less Sales of Waste	2,150		
Total	$49,100		
Direct Labor	52,400		
General Labor	1,400		
Trucking	620		
Power	9,800		
Repairs	1,300		
Miscellaneous Supplies	2,900		
Employment Department (including medical attendance and nursery)	1,400		
Office	1,000		
Administration Salaries	2,200		
General Expense	800		
Interest	2,200		
Insurance	1,700		
Taxes	700		
Patent Legal and Collection	60		
Depreciation	7,700	135,280	
Tenement Rentals			$ 75
Discount on Purchases			290
Sales			140,700
Sales Freight		370	
Sales Discount		2,200	
Sales Commission		3,000	
Closing Inventory			1,050,200
Gain		12,715	
		$1,191,265	$1,191,265

cloth, standards of weights had been determined. Since the cloth was sold on a pound basis, the addition of standard percentages for indirect labor and overhead had been considered an accurate method of costing. The cost of the sweaters was divided into material, labor, and overhead. The number of pounds to a dozen

was determined from past records, and labor and overhead were added to a material cost per pound to make up the total cost. The labor cost included direct and indirect labor, the former being on a piece-rate basis. The total labor per pound was determined by adding a percentage to direct labor for the indirect labor. Similarly burden was applied as a percentage of total labor cost. The management considered this a fair way of distributing burden cost, since it believed that administration, clerical work, supplies, and all the various items of burden were incurred in proportion to the amount of labor applied to a pound of material, regardless of the processes through which that material went.

An operating statement similar to the one on page 207 was prepared each month.

In this system what provision should have been made for burden costs in the monthly inventories? Should burden have been distributed to operating departments? If so, what bases for distribution should have been used for each of the items?

3. ALLEGRO PHONOGRAPH COMPANY—DISTRIBUTION OF BURDEN

The Allegro Phonograph Company manufactured two lines of phonographs in 23 models ranging in price from $50 to $3,000. One line had 10 models ranging in price from $50 to $300. This was the standard line, and its sales were 90% of the total number sold. The other line had 13 models which filled out the price range to $3,000; these machines were of rare woods, in period designs and hand carved. All the work in the manufacture of cabinets was done in the plants of the company, but motors and other mechanical parts were purchased and assembled in the machines after the production of the cabinet. The annual output was 40,000 machines at an average cost of $125. Ninety per cent of the cost was for material and labor and only 10% was overhead charges. Eighty per cent of the labor in the company's factory was on a piece-rate basis. The factory was divided into 25 departments with machine operations in 22. Over 300 operations were performed in the manufacture of each cabinet.

The company distributed burden by means of a budget based on labor-hours. Tests had been made on the number of hours spent in the production of a machine of each model. The esti-

mated production in each model for the year was multiplied by the hours determined by the test. The overhead on each model was based on its percentage of production hours to the estimated total production hours. The number of machines made of each model during the year multiplied by the overhead rate for that model gave the total amount of overhead applied. This had been found unsatisfactory because frequently under the time economies resulting from mass production more burden was absorbed than actually had been expended. Since the overhead was always underabsorbed or overabsorbed, the difference had to be charged off at the end of the period. Consequently the cost of the product was not accurately determined. It was also found that when production increased, overhead increased too, although not in direct proportion.

Since a large part of the labor on Allegro cabinets was on a piece-rate basis, it was believed advisable to change the method of allocating burden to a labor-dollar basis. Under this plan the payroll of the entire factory was totaled, and the proportion of each department's payroll to the whole was taken as the ratio of overhead to be borne.

4. WORLD FURNITURE COMPANY—ACCOUNTING FOR OVERHEAD

In 1922 the World Furniture Company manufactured more than 800 pieces of office furniture of various grades. It was compelled by competition to introduce an accurate cost system. The system in use consisted merely of time cards taken from the time clock (see Form 30, page 210), time cards kept in the department by the foremen (see Form 31, page 211), and material requisition slips. These records were designed with the fact in mind that they either had to be simple enough to be kept by the foreman without undue burden, or that they had to be automatic, since most of the employees in the factory were Portuguese who could not read or write English.

The main difficulty in the cost accounting department was the determination of the basis on which to distribute the overhead. Since the machinery used by the company was elementary, the investment in it was moderate, and the introduction of a machine-rate system of burden distribution, therefore, was not being considered. The company's principal competitors allocated over-

THIS SIDE OUT

NO.
NAME

WEEK ENDING _____ 19

NO.
NAME

DAY	MORNING		AFTERNOON		LOST OR OVERTIME		TOTAL
	IN	OUT	IN	OUT	IN	OUT	
MON.							
TUE.							
WED.							
THU.							
FRI.							
SAT.							
SUN.							

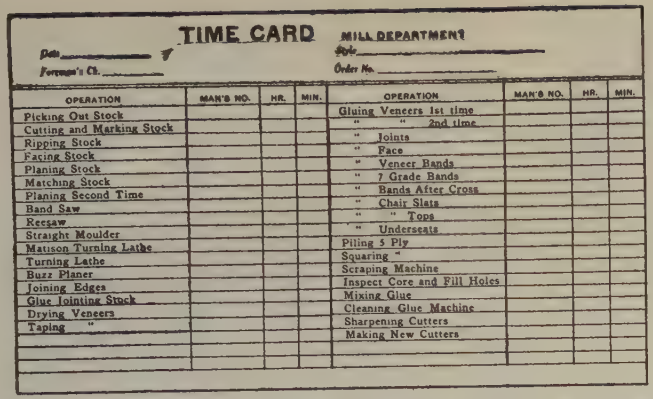
TOTAL TIME _____ HRS.
RATE _____
TOTAL WAGES FOR WEEK $ _____

Form 30: Clock Time Card—Face and Reverse

head to product on the basis of the direct-labor payroll or the productive hours.

The World Furniture Company's largest competitor, The Business Service Company, manufactures not only office furniture, but also hundreds of cards and forms for recording purposes. In its factory there were 21 departments, within each of which the labor was of an even grade. In the departments in which the machinery was expensive, the rates of pay were comparatively high, and in departments such as that where the cards were packed, in which practically no machinery was used, the amount of space occupied per employee was large enough so that, taken in connection with the wages paid the girl packers, the overhead was being distributed equitably.

The Office Equipment Company was engaged in the manufacture of furniture exclusively. In its departments it employed helpers to assist the more skilled workman. The cost accountant believed that inasmuch as a helper occupied as much space as a skilled workman and required as much, if not more, supervision, the distribution of the overhead on the basis of the direct-labor

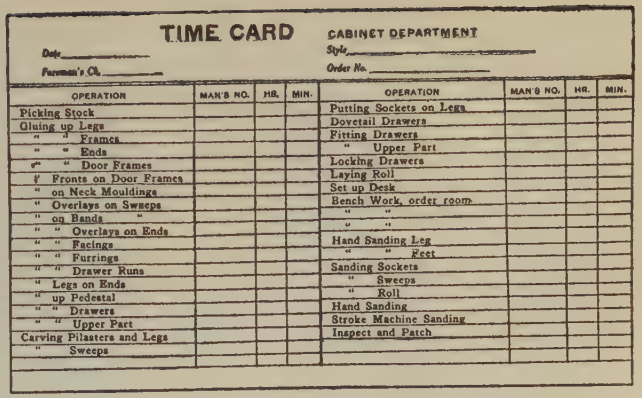


TIME CARD MILL DEPARTMENT

Date _____ Style _____

Foreman's Ch. _____ Order No. _____

OPERATION	MAN'S NO.	HR.	MIN.	OPERATION	MAN'S NO.	HR.	MIN.
Picking Out Stock				Gluing Veneers 1st time			
Cutting and Marking Stock				" " 2nd time			
Ripping Stock				" Joints			
Facing Stock				" Face			
Planing Stock				" Veneer Bands			
Matching Stock				" 7 Grade Bands			
Planing Second Time				" Bands After Cross			
Band Saw				" Chair Slats			
Reesaw				" " Tops			
Straight Moulder				" Underseats			
Matison Turning Lathe				Piling 5 Ply			
Turning Lathe				Squaring "			
Buzz Planer				Scraping Machine			
Joining Edges				Inspect Core and Fill Holes			
Glue Jointing Stock				Mixing Glue			
Drying Veneers				Cleaning Glue Machine			
Taping "				Sharpening Cutters			
				Making New Cutters			

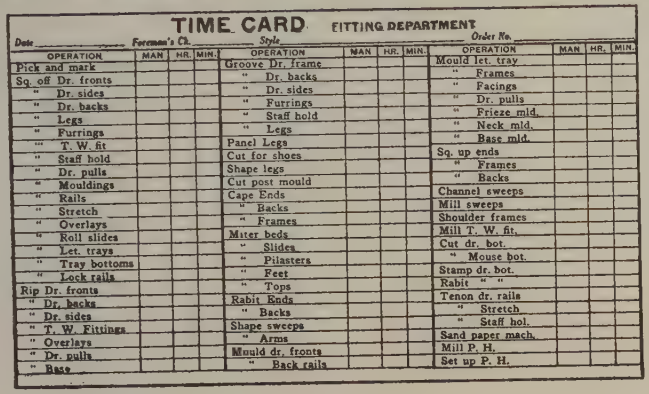


TIME CARD CABINET DEPARTMENT

Date _____ Style _____

Foreman's Ch. _____ Order No. _____

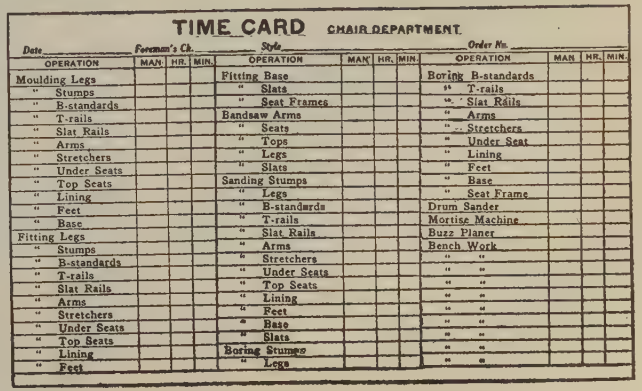
OPERATION	MAN'S NO.	HR.	MIN.	OPERATION	MAN'S NO.	HR.	MIN.
Picking Stock				Putting Sockets on Legs			
Gluing up Legs				Dovetail Drawers			
" " Frames				Fitting Drawers			
" " Ends				" Upper Part			
" " Door Frames				Locking Drawers			
" Fronts on Door Frames				Laying Roll			
" on Neck Mouldings				Set up Desk			
" Overlays on Sweeps				Bench Work, order room			
" on Bands "				" "			
" " Overlays on Ends				" "			
" " Facings				Hand Sanding Leg			
" " Furrings				" " Feet			
" " Drawer Runs				Sanding Sockets			
" Legs on Ends				" Sweeps			
" up Pedestal				" Roll			
" " Drawers				Hand Sanding			
" " Upper Part				Stroke Machine Sanding			
Carving Pilasters and Legs				Inspect and Patch			
" Sweeps							



TIME CARD FITTING DEPARTMENT

Date _____ Foreman's Ch. _____ Style _____ Order No. _____

OPERATION	MAN	HR.	MIN.	OPERATION	MAN	HR.	MIN.	OPERATION	MAN	HR.	MIN.
Pick and mark				Groove Dr. frame				Mould let. tray			
Sq. off Dr. fronts				" Dr. backs				" Frames			
" Dr. sides				" Dr. sides				" Facings			
" Dr. backs				" Furrings				" Dr. pulls			
" Legs				" Staff hold				" Frieze mld.			
" Furrings				" Legs				" Neck mld.			
" T. W. fit				Panel Legs				" Base mld.			
" Staff hold				Cut for shoes				Sq. up ends			
" Dr. pulls				Shape legs				" Frames			
" Mouldings				Cut post mould				" Backs			
" Rails				Cape Ends				Channel sweeps			
" Stretch				" Backs				Mill sweeps			
" Overlays				" Frames				Shoulder frames			
" Roll slides				Miter beds				Mill T. W. fit,			
" Let. trays				" Slides				Cut dr. bot.			
" Tray bottoms				" Pilasters				" Mouse bot.			
" Lock rails				" Feet				Stamp dr. bot.			
Rip Dr. fronts				" Tops				Rabit " "			
" Dr. backs				Rabit Ends				Tenon dr. rails			
" Dr. sides				" Backs				" Stretch			
" T. W. Fittings				Shape sweeps				" Staff hol.			
" Overlays				" Arms				Sand paper mach.			
" Dr. pulls				Mould dr. fronts				Mill P. H.			
" Base				" Back rails				Set up P. H.			



TIME CARD CHAIR DEPARTMENT

Date _____ Foreman's Ch. _____ Style _____ Order No. _____

OPERATION	MAN	HR.	MIN.	OPERATION	MAN	HR.	MIN.	OPERATION	MAN	HR.	MIN.
Moulding Legs				Fitting Base				Boring B-standards			
" Stumps				" Slats				" T-rails			
" B-standards				" Seat Frames				" Slat Rails			
" T-rails				Bandsaw Arms				" Arms			
" Slat Rails				" Seats				" Stretchers			
" Arms				" Tops				" Under Seat			
" Stretchers				" Legs				" Lining			
" Under Seats				" Slats				" Feet			
" Top Seats				Sanding Stumps				" Base			
" Lining				" Legs				" Seat Frame			
" Feet				" B-standards				Drum Sander			
" Base				" T-rails				Mortise Machine			
Fitting Legs				" Slat Rails				Buzz Planer			
" Stumps				" Arms				Bench Work			
" B-standards				" Stretchers				" "			
" T-rails				" Under Seats				" "			
" Slat Rails				" Top Seats				" "			
" Arms				" Lining				" "			
" Stretchers				" Feet				" "			
" Under Seats				" Base				" "			
" Top Seats				" Slats				" "			
" Lining				Boring Stumps				" "			
" Feet				" Legs				" "			

Form 31: Department Time Cards

payroll would lead to erroneous conclusions. At an expense of $15 per week for an extra clerk to compute the necessary calculations, he was making his distributions on the basis of productive hours, and he was satisfied that this method was best for his purpose.

In comparison with the competitors mentioned, the World Furniture Company was a small manufacturer. Most of its work was done on specific orders, whereas theirs was done for stock, and it did proportionately more handwork than either of them. The grades of direct labor within its departments varied somewhat, but not nearly as much as in the case of the Office Equipment Company.

Which system of overhead distribution should have been adopted by the World Furniture Company?

5. THE HAMPTON PRESS—ACCOUNTING FOR OVERHEAD

At the Hampton Press where four Jones presses were operated, one man handled two presses, so that his hour pay rate was divided equally between the work done on each of his machines. Recently a helper was hired at $16 a week to assist the operators and to do general odd jobs about the factory, such as sweeping and cleaning. The proportion of his time spent assisting the pressmen was large, but as it varied widely from week to week, it was almost impossible to estimate it in advance. His wages were divided by two, and one-half added to the pay of each pressman before his wages were prorated. Since a portion of the helper's time was spent on odd jobs, the cost accountant wished to include his wages in the general factory overhead.

The comptroller of the company desired to charge directly as many items of manufacturing costs as possible. He suggested that the actual proportion of the boy's time spent in assisting the pressman in one month should be used to ascertain the percentage of his wages to be added to the pressman's wages during the following month, and that the remainder be charged proportionately to the departmental overhead accounts. The company charged off unabsorbed or overabsorbed burden monthly to a manufacturing profit and loss account, which was closed at the end of the year into the general profit and loss account.

The method of burden distribution in use was a sold-hour rate, a machine rate which included the pressman's wages.

Which method of accounting for the helper's wages should the Hampton Press have adopted?

6. ATLANTIC COAST SHIPBUILDERS ASSOCIATION—DISTRIBUTION OF FIXED CHARGES

During the period of the war the activities of the Emergency Fleet Corporation resulted in the construction of numerous shipbuilding plants along the Atlantic coast. Many of these plants at the end of the war were members of the Atlantic Coast Shipbuilders Association. The lack of uniformity in the accounting systems used by the different companies made it difficult to compare costs between units and plants. In order to insure more uniformity in the future, a committee was formed by the association to recommend uniform methods of cost accounting for the industry.

The following quotation on the distribution of fixed charges is taken from the first report and recommendation of that committee on uniform methods of cost accounting in shipbuilding.

Distribution of Fixed Charges. The fixed charges indicated below will be distributed separately, period by period, to the various departments according to the value and nature of fixed assets, or service obtained. The total of these accounts chargeable against a definite department for a period constitutes the fixed charge for that department.

It is suggested that reserve accounts be set up for each fixed charge, to which should be credited each period the amounts which are charged to production. The basis of the amounts which should be credited to the reserve accounts and the charges to production costs are set out under the respective headings of fixed charges.

Rent or Floor Space. Rent or floor space costs, where such are paid for use of property in connection with production, should be applied to the respective departments using such space. The total of such charges should be prorated period by period to the departments according to the floor space occupied.

The scale of floor rates, which should be prepared in advance, should have a relation to the desirability of the space.

Interest on Fixed Assets. The method of treating interest on investment in cost finding is one that has been discussed perhaps to a greater extent than any other expense distribution matter. There is no intention of discussing the different opinions on this question in this report.

It is clear that where the output of any works consists of a number of products of differing types and character, the manufacture and assembling of which require different classes of plant, machinery, and equipment, each involving large expenditures, the interest on the cost of such machinery and equipment should be included in production costs. Only through this means will it be possible to obtain the actual cost of different products and proper distribution of charges against the job accounts or orders.

Because of the number of activities and great variations in the types and costs of plant, machinery, and equipment required, consideration should be given in costs to the amount of capital invested. This should be treated in the form of interest on fixed assets, which should be applied as a part of the fixed charge expense.

The basis of the interest on fixed assets charge should be the net value of the plant assets, i. e., the cost of plant, machinery, and equipment less the amounts written off for amortization and depreciation. A normal fixed rate of interest should be used in calculating the interest charge. This charge should be apportioned to the various departments based upon the net value of the fixed assets.

Insurance. Insurance, including fire, burglary, fidelity, and employers' liability insurance should be distributed according to the aver- costs, and such expense should be distributed to the departments on the basis of value of plant equipment or material. In the case of employers' liability insurance should be distributed according to the average amount of salaries and wages chargeable to each department.

Taxes. Taxes, including general property taxes, municipal, state, and United States Government taxes, should be treated as part of production costs. All income taxes, excess profit taxes, and capital stock taxes are not proper charges against production costs, and should be charged to profit and loss.

Taxes on property, machinery, and equipment, will be distributed according to the value of such property, machinery, and equipment in each department.

Taxes on express, freight, and drayage should, wherever it is practicable, be charged directly to the cost of material or supplies. When such treatment is impracticable, it should be treated as part of the general works expense.

Depreciation. The following paragraph is taken from the report of the Committee on Depreciation and shows the important elements in depreciation which were considered by the Committee:

"Shipyards must not only provide for the normal depreciation, that is, the depreciation due to wear and tear and obsolescence; but must also allow for the increase in this normal depreciation due to the increased time of use of plant and equipment through overtime operation; and are further faced with the necessity for amortizing the 'special depreciation' of those improvements which have been installed during

the war, due to the war inflation of the labor and material market existing at the time these improvements were carried out, and the special purpose of the improvements which will disappear in whole or in part on the termination of the war contracts."

The summary conclusions of the Committee, which have been adopted by the Association, are as follows:

"1. That the straight-line method of charging off depreciation be adopted.

"2. That when possible the detailed classification of plant facilities given in the table be adopted, together with the corresponding rates of normal depreciation stated in the last column of the table.

"3. That in cases where this detailed classification cannot be applied owing to lack of data or for other reasons, the more general classification indicated in the first column of the table may be adopted, with the corresponding rates.

"4. That the normal rates of depreciation be increased to cover overtime depreciation, this increase being at the rate of 6¼% of the normal rate for each hour of overtime; all time in excess of the standard eight-hour day being considered overtime, in this connection. This rate of increase corresponds to 100% increase in normal rates when the plant is operated for the full 24 hours.

"5. That a special depreciation reserve account be maintained by each company to which shall be credited the estimated special depreciation for all improvements undertaken while this country was at war and carried out at the contractor's expense, at a tentative rate of 20% of the expenditure for such improvements per year, for the calendar years 1918 and 1919; and that on December 31, 1919, an appraisal shall be made by a joint board for each year and final adjustment made of the above reserve account.

"6. That the rates here recommended for depreciation of all kinds be applied from January 1, 1918."

Charges for depreciation should be applied to the various departments on the basis of the value of buildings, machinery, and equipment, and should be distributed to the job accounts or orders with the other fixed-charge expense.

Distribution of Expense. The uniform method which should be used in distributing expense to the product units or job accounts, includes the following main steps:

(a) All items of indirect costs or expense, for any period in question, falling under the respective expense classifications should be assigned to the respective departments or to the non-departmental expense accounts.

(b) The total expenses which are directly or indirectly attributable to the operation of each of the general works distributive departments should then be distributed over the other departments on the basis of the amount and character of services furnished.

(c) The total productive departmental expense—and the auxiliary and stock manufacturing expense—in the respective production departments, should be distributed to each product unit or job account.

(d) The total expense of the general works departments and the proper proportion of the general administrative expense which is chargeable to costs and the auxiliary and stock manufacturing departments, should be distributed to the product unit or job accounts, through the respective productive departments or auxiliary and stock manufacturing departments.

(e) In the case of shipbuilding companies having more than one yard, the central general administrative expense which is chargeable to production should be apportioned to each plant.

In those cases where there are no auxiliary and stock manufacturing departments, the method of expense distribution will be simplified to that extent, as it will not be necessary to assign parts of the general works expense and general administrative expense to such activities.

Application of Expense. With the distribution of the various expense items to productive departments—and such auxiliary and stock manufacturing departments as may exist—a uniform basis for the application of such expenses to the product units or job accounts should be used.

The following basis is suggested for use in the application of expenses in all shipyards:

(a) The total of such costs of the general works distributive departments as power, light, and heat service, and the like, should be apportioned to the various departments on the basis of the actual service or benefit received by each department. Where it is possible the distribution should be made according to meter readings or floor space used. Where meters are not installed, estimates of the horse-power used by various machines, wattage of lamps for light service, the floor space occupied for heating, and so forth, should be used.

(b) The general works expense should be distributed to the productive departments—and to such auxiliary and stock manufacturing departments as may exist—on the basis of the total labor cost in the particular period in each operating department. After such general works expense has been distributed to the respective departments, it should be applied to the product units or job accounts on the basis used for the application of productive departmental expense, namely, direct-labor hours.

(c) The basis suggested for use in the distribution and application of general works expense should be used for the distribution and application of the general administrative expense. This applies both to the case of distribution of central general administrative expense to the individual plants, and to the distribution of the general administrative expense of any one plant to the productive departments and to the product units or job accounts of the individual plants.

(d) The productive departmental expense, as well as auxiliary and stock manufacturing expense, should be applied to the product units or job accounts on the basis of direct-labor hours.

7. SHAFFER MACHINE WORKS—OVERHEAD—DISTRIBUTION BY MACHINE-HOUR COST

The Shaffer Machine Works distribute their overhead, under their present system of cost accounting, in the manner described below. Anderson and Porter, accountants, the firm which does the audit of the Shaffer Machine Works, is studying this system, and the problem before them is whether to revise the method of overhead distribution now being used, or whether to retain it unchanged.

Standard machine-hour rates, based on previous experience of costs and normal running hours, are worked out, and burden is applied currently to jobs by means of these machine rates. The usual accumulation methods show how much burden has been thus absorbed, or charged to jobs, in each department. At the end of the period the actual expenses are assembled on a sheet as given herewith, distributed to departments on the basis shown, and the totals so arrived at compared with the total amounts of burden which have been charged to jobs at the standard rates. This form, therefore, serves two purposes; it shows a distribution of the actual burden; and also, by comparing the actual expense with the standard expense allocated, it provides the correcting factor to be applied to current machine rates to make them satisfactory for the coming period.

Accumulation of Shop Expenses. At present all the actual expenses other than direct material and labor are gathered at the end of the month under five heads as follows:

1. Operating Expense
2. Auxiliary Shop Expense
3. Tool and Pattern Department Indirect Expenses
4. Manufacturing Department Indirect Expenses
5. Drawing Room Indirect Expenses

The operating expense includes such general expenses of the factory as the wages, supplies, and other expenses of each of the following: general office, order clerk, purchasing and shipping de-

partments, watchmen, restaurant, factory magazine, and other welfare work.

The auxiliary shop expense, i. e., the auxiliary expense of supervising and facilitating shop work, contains the general costs of directing the operations of the manufacturing departments. It includes the power, heat, and light, boxing expense, the wages of storekeepers and balance clerks, the expenses of the cost, planning, and routing departments, losses from spoiled material, and the expense of conducting manufacturing experiments.

The last three headings between them contain all the other indirect departmental expenses such as indirect material and labor, departmental repairs, upkeep of buildings and equipment, and the fixed charges.

Distribution to Producing Departments. The foregoing represents the first general gathering together of burden expenses. The next main step is the redistribution of these five classes of expense to accounts representing the producing departments. These are as follows:

1. Part Construction, or construction of new equipment about which there is a dispute as to whether it should be capitalized or charged to expense
2. Construction, or the work done in making additions to plant and equipment
3. Worked materials, or the account for work in process
4. Drawings, which is treated as a separate producing department
5. Stores Sold, or the expense of handling materials sold from stores, without manufacturing work having been done on them

The work of distributing the shop expenses to these five production accounts proceeds as follows:

1. Operating Expense is distributed to Part Construction, Construction, and Worked Materials on the basis of the direct wages paid in those departments.
2. At this point the Part Construction total is divided equally between Auxiliary Shop Expense and Construction.
3. The Auxiliary Shop Expense is then distributed to Tool and Pattern Department, Manufacturing Department, and Drawing Room. This distribution is made on the basis of the machine

costs which have been charged to production, within each of the departments named, at the standard machine-hour rates.

4. Tool and Pattern Department total expense is now allocated to Manufacturing Department, Construction, and Worked Materials, also on a basis of standard machine costs actually charged to production in these three departments.

5. The Manufacturing Department Expense now accumulated is overhead on work in process, and is accordingly transferred to Worked Materials. If Worked Materials is subdivided into different kinds of product, the total would be apportioned among them in proportion to the machine burden which has been attached to each.

6. Drawing Room Expense is divided between Construction and Drawing on the basis of burden for each of these departments already applied to product at the standard rates.

7. In Stores Sold column, 5% of the quantity of stores shown as having been sold is charged as handling expense; the same amount is credited in the Auxiliary Shop Expense column.

This completes the shop expense distribution; all burden is now allocated to the producing departments.

Machine Rate Computation. The machine rates above referred to are found by allocating all the expense of the department in question to the several machines within it, on a suitable basis somewhat as follows:

1. Building charge (based on a share of the total cost of maintaining the buildings proportionate to the square feet of floor space occupied by the machine)
2. Depreciation (from 5% to 10% of original cost of machine)
3. Taxes (prorated on depreciated value of machines at the first of the year)
4. Insurance (prorated on depreciated value of machines at first of the year)
5. Stores and Supplies (actually used during the past year prorated to machines)
6. Repairs (actually made during the past year on the machines in question)
7. Tools and jigs (used during the year on that particular machine)

8. Planning expenses (prorated)
9. Functional foremen (prorated)
10. Miscellaneous labor actually charged to that machine during the year

The total horse-power-hours for the factory (obtained by multiplying the hours run by each machine by its rated horse-power consumption, and adding them to get the total for all machines) is divided into the total cost of power for that year to determine the cost per horse-power-hour. From this the cost of power for each machine for any month during the year following is determined by multiplying this cost per horse-power-hour (obtained from the previous year's actual figures) by the normal hours that the machine was to be run during the month in question. This is added as an eleventh item to the items listed above as "machine expense." The final total is divided by the normal number of hours run by the machine to get the computed rate of machine-hour cost for each machine. For ease in calculating, the figure taken is the nearest whole number of cents.

At the end of a year, the actual number of hours run by each machine is expressed as a percentage of the total possible running hours, as an index of the efficiency with which the company uses these machines.

The distribution of indirect expense to jobs is then made by taking the hours run on each job, and multiplying them by the machine rate in question. If all expenses have been as much as anticipated, and if machines all run the normal number of hours, the total burden charged to production in these machine rates will be equal to the total amount of burden expenses actually incurred.

Should this method of distributing overhead be continued?

What would be the machine-hour cost of the Perkins Engine Lathe Number 14 at the Shaffer Machine Works to be used in figuring 1921 monthly overhead distributions? The 1920 figures on which it is based are as follows:

COST OF MAINTAINING THE BUILDINGS

Depreciation	$ 8,973.84
Care of grounds	694.70
Repairs and upkeep	6,862.12
General factory lighting	235.27

Cleaning	$ 184.12
Heating	727.91
Insurance on buildings	5,376.51
Taxes	6,720.28
	$29,774.75

Area available for manufacturing—67,196 square feet
Area required by Engine Lathe Number 14, including share of aisle space—60 square feet
Original cost (bought the year previous) of Engine Lathe Number 14 $408.66
Depreciation 7½%

During 1920 there were 2,600 working hours at the Shaffer Machine Works. Work reported on Engine Lathe Number 14 totaled 2,080 hours. The normal running hours for this lathe are computed at 2,400 per year. The cost of power for the factory was $0.013 per horse-power-hour. The horse-power required to operate Engine Lathe Number 14 is .75.

Other charges against the Perkins Engine Lathe Number 14 were as follows:

Proportion of taxes	$ 5.26
Proportion of insurance	6.30
Proportion of stores and supplies	19.15
Repairs	17.64
Tools and jigs used	84.37
Proportion of planning expense	34.79
Proportion of functional foremen	65.31
Miscellaneous labor used in maintaining it	35.19
	$268.01

8. SHAFFER MACHINE WORKS—OVERHEAD DISTRIBUTION PROBLEM

The actual expenses for April, 1923, were collected together for checking up with the amounts charged to product at the standard rates, as described in the previous problem, and showed the figures given on page 222.

APRIL, 1923, TOTALS

Item	Wages	Stores	Miscellaneous Journal Entries	Prorated General Accounts (Supplied from the Treasurer's Office)	Accounts Payable
Operating Expense	$2,962.60	$ 76.58	$ 96.98		$ 508.90
Auxiliary Shop Expense	3,545.01	2,136.74	343.95	$282.32	3,798.45
Tool and Pattern Department	645.55	76.41	3.49		42.00
Manufacturing Department	4,553.39	1,445.58	68.82		36.08
Drawing Room	476.01	56.57			4.12
(Totals)					
Part Construction	6.79	242.55			176.67
Construction of Machines	1,303.27	95.04	21.74		240.00
Worked Materials	9,607.54	14,274.47	1,770.36		1,024.93
Drawings	201.02				
Stores Sold		922.96			
(Grand Totals)					

The amounts which have been charged to production for burden, at the standard machine rates, had during April amounted to the following sums in the departments shown:

For the Tool Room

$1,184.49 In the manufacturing department
913.77 Construction
526.93 Worked materials
$2,625.19 Total tool room machine-hour cost

For the Manufacturing Department

$9,080.61 Worked Materials (line Number 13)

For the Drawing Room

$389.50 Construction (line Number 20)
201.02 Drawings
$590.52 Total for Drawing Room (line Number 13)

In distributing the Auxiliary Shop Expense, Account A, the machine-hour cost is "weighted" by taking (for this calculation only):

One-half the total Tool Room machine-hour cost for DT	$ 1,312.60
All of the Manufacturing Department machine-hour cost for DM	9,080.61
One-tenth of the Drawing Room machine-hour cost for DD	59.05
	$10,452.26

(This total is used in calculation number 13 in column L.)

What are the total charges to Construction, Worked Materials, Drawings and Stores Sold after the overhead has been applied?

(It is recommended that a distribution be made on a form similar to that shown in the previous problem.)

9. THE TEXT PRINT—ACCOUNTING FOR OVERHEAD

The Text Print, which composed, printed, and bound textbooks for publishers, operated 25 cylinder and 4 job presses. Hitherto each job was charged from the requisition slips for any materials requisitioned. Paper, the principal raw material, generally was furnished by the publisher for whom the work was done. Labor was charged from the employees' time slips. Considerable clerical work was involved in handling these slips because the presses were manned in various ways. In some cases a pressman and helper were required to operate one or two machines; in others, pairs of presses were manned by a pressman and two helpers. Some presses were fed sheets of paper by hand, whereas others were automatically fed a large quantity of paper at one time by load feeders. A man working on two machines filled out a time slip for the work done on each. Load-feeder operators, however, worked on one ticket for an entire week and their wages were included in the general overhead, with the result that machines fed by hand were charged a portion of the load-feeding charges. Overhead costs were distributed as a percentage of the direct-labor payroll. Because of the clerical labor involved in making the charges for direct labor, and the inequitable distribution of burden resulting from the method in use, a machine rate which would include direct labor was recommended as a basis for distribution.

In working out the machine rates it was estimated that the

pressroom would normally run 2,400 hours per year, or 48 hours per week, with an allowance for holidays. A pressman's hourly rate, therefore, was multiplied by 2,400 to determine his yearly wages. The yearly wages of pressmen, helpers, and load-feeder operators were divided equitably among the machines, and the total yearly labor cost for each machine for 2,400 hours found. Interest at 6%, depreciation at 10% of the last book value, taxes, and insurance were figured for each machine on a yearly basis. A charge to each machine for insurance and interest on work in process was determined by taking the estimated average inventory of work in process for the coming year and dividing the charge equally among the machines. Since all presses occupied practically the same amount of space, the rental costs also were divided equally. About $3,000 worth of miscellaneous equipment was used in the pressroom, and 10% of this amount was charged to the presses on an equal basis for depreciation. Repairs, including machinists' labor, were estimated for a year and charged equally to the machines. Estimated yearly supplies and expenses were divided among the presses on the basis of size, or output. The salaries of janitors and the expenses of building repairs were prorated on the same basis, as were miscellaneous labor such as for repairs to rollers, errors, and compensation insurance. Direct and overhead costs of each error were charged to an error order number, the total of which was to be compared at the end of the year with the estimate as an aid to future rate setting. The actual horse-power of each machine was estimated, and a yearly power charge for each machine figured. Charges for the watchmen, general repairs, heat, light, water-cooling, accounting service, and foundry were divided equally over the presses. General stores expense and the charge for elevator service were prorated to the machines on the basis of size. The total yearly charge for each machine was divided by 2,400 to find the machine's hour-rate.

The chief objection to this method of computing the rates was the elaborate calculations which would be called for at the beginning of each year. Since the rates would be based largely on estimates, the distribution of burden might not be any more accurate under this method than in the past. On the other hand, if machine rates were introduced, a minimum rate for setting-up time, an additional rate to be added during running time, and a sepa-

rate rate to be charged for idle time could be worked out for each machine, in order to obtain as accurate costs as possible. Power charges, however, were relatively small and some power was used even when the machine was being set up. The hourly charges for each machine varied chiefly with the amount of labor involved. Inasmuch as work done on a new machine would have a higher hourly rate than identical work done on an old one, it was suggested that the presses be grouped into classes and an average hourly rate worked out for each class.

Which method of overhead distribution should the Text Print have adopted?

10. GRAVES-PIATT COMPANY—SETTING MACHINE RATES

In the Graves-Piatt plant there were 15 departments, in 11 of which machine operations were performed. Machine rates had been set up for each department. These rates were fixed by outside specialists. The company had an expert engineer determine the method which should be used in setting up machines. A time-study man then made calculations of the time required, and the rate to cover setting-up and running time. This rate included space cost, use cost, repair cost, and set-up cost, but no provision had been made for the absorption of idle time charges by means of an addition to the operating rate. Such costs were left in the general overhead and would be unabsorbed in case of idle time arising.

The Graves-Piatt Company manufactured glass and metal syringes, hypodermic needles, and other surgical and clinical supplies, with a minor line of small automobile parts, such as grease guns and signals, totaling 8,000 items composed of 17,000 parts. No products were manufactured for stock, but parts were made and carried in worked material stores, so that products could be assembled upon the receipt of orders.

The automatic screw department, for example, had 11 machines, only eight of which were kept in operation at one time by the company's production schedule. Two of the other machines provided insurance in case of breakdowns and permitted the continuous operation of eight machines while set-ups were being made. Every machine in this department had an operating rate; no provision had been made, however, for the idle time

charges for the two machines not running. The third idle machine produced a particular type of machine screw and was in use only one-quarter of the time. The charge of this machine included idle time carrying charges.

This situation illustrated the policy of the company. The reason given was that frequently jobs were accepted at a low figure in order to obtain connections with a new customer and eventually obtain business from him in other lines. The general manager was convinced that if idle time were included in the cost of the product, many orders would be lost not only on the low-priced products which were used to secure the customers' business, but also on the other profitable business secured as a result of the concessions on a few items. One member of the firm asserted that the system employed by the company hid the facts. He believed that even though losses would be shown on certain jobs if idle time were included as a charge, this should be done in order to control the amount of business of this type which should be accepted. One argument advanced in favor of the retention of the company's policy was that additional clerical labor to handle idle time costs would add further to the cost of the company's products if idle time were taken into account. There was force in this argument, because of the multiplicity of departments and products.

Should the Graves-Piatt Company set up a minimum rate and an additional rate for running its machines, together with provisions for idle time charges?

II. RED METAL MANUFACTURING COMPANY—SECTION B—A FURNACE-HOUR RATE FOR A BRASS CASTING SHOP

The works cost accounting department has presented to the comptroller a set of furnace-hour rates to be used in charging operating costs of the casting division to the product, in place of the present methods.

The system in force at the present time is as follows: Each master caster operates under normal conditions five or six furnaces at a time; he is paid on a piece-work basis, the rate being expressed as so much per hundred pounds of good metal produced; and his helpers are paid so much a round, or charge.[1]

[1] A charge is the term used to describe one furnace cycle which consists of placing the raw material (copper and zinc) in the furnace, heating it to the

The sum of the caster's piece-rate and the helper's rate-per-charge constitutes the direct labor involved. All other costs, including foremen, core-making, fuel, maintenance, depreciation and rent, are grouped into one sum. The caster's piece-rate tickets indicate the shapes upon which he has worked and the amount of time consumed. The helpers' wages are allocated to the product in the same proportion as the caster's, and overhead is loaded as an arbitrary percentage of the direct labor based upon past experience. Large balances of over or underabsorbed burden are common at the end of the month.

Recently some refinements of cost method have been introduced whereby overhead is added as a percentage of direct labor, differing according to the kind of mixture in question, since bronze, for example, takes roughly twice as long to melt as brass, while copper takes one and one-half times as long as brass. But for some time it has been apparent that in order to meet competitive conditions a still more detailed and exact method of cost accounting for the casting shop work is necessary.

Proposed Furnace-Hour Rate. A test period of three months was decided upon. The potential theoretical production of the plant for a three months' period was computed by the engineers as 6,000,000 pounds. Allowing for repairs and idleness of equipment for all reasons, the engineers established a normal volume of production of 4,000,000 pounds. On this production all estimates were based in order to give exact absorption of overhead under normal conditions. Actual performance for the three months was recorded and adjusted in each case to the normal production which was assumed to be 4,000,000 pounds.

Rent. The engineers, taking into consideration the type of building (Class A, B, or C construction) and the utility of the space for the purpose for which it was used, evaluated all space in the various buildings. If a department was in an inferior location, it received the benefit of the cheaper rent, but if it was in a better room than necessary, it was not penalized by a higher rent. All floor space was given a weight based upon a first floor in a

proper temperature, stirring, and pouring into molds. The average cycle is of 1½ to 2 hours' duration; the higher the zinc content, the shorter the time required. Heating is continuous throughout the cycle; the raw material is put into the furnace a little at a time, which is allowed to melt before more is added. Pouring is commenced about half an hour after the last addition.

Class A building rating 100%. A square-foot rate, used to apply rent to departments, was obtained by dividing the total rent of all buildings by the total weighted area. The casting department accordingly was responsible for the weighted area of its floor space times this unit rate. Although in this space, there were 33 furnaces of three types which varied slightly in size, the variation was considered small enough to be ignored. Since it was estimated that 30,000 furnace-hours would be required to produce the established normal production of 4,000,000 pounds, an hourly charge for rent was obtained by dividing the total rent cost by 30,000.[1]

Power. The actual coal consumption of the three types of furnaces was recorded during the test period. Since the production of this period was below normal, the fuel consumption was increased to represent the assumed normal production. The relative operating time of the three types of furnaces was established by a study of past records. It was found that type C operated only about 2,500 hours to produce the normal production as against 27,500 hours for types A and B. By dividing the total cost of fuel consumed by each type of furnace by the number of hours it must operate to produce the normal production, a fuel-hour rate for each type was obtained which was added to the first element of rent.[2-3]

Relining and Repairs. Actual repairs for each type of furnace were analyzed over a period of six months, including the three months' test period. This figure, which was corrected to allow for normal production, was divided by the total number of hours necessary for each type of furnace in order to secure an hourly charge to be added to the elements already determined. It was found that type B furnace required 40% more maintenance than type A, while type C required 20% less than type A. The total relining and repair charges were apportioned accordingly.[4]

[1] *See* page 233, Table 6.

[2] Six different furnace-hour rates were eventually found to be necessary to cover the three types of furnaces and various shapes of rods and bars which required different equipment and different amounts of labor in connection with the pouring.

[3] In case electric furnaces were employed, records would be kept of kilowatt-hour consumption per furnace instead of fuel consumption.

[4] *See* page 233, Table 6.

Direct Labor. Two factors entered into determination of direct labor; the average number of furnaces used during the period, and the average number of men per furnace, per shape poured. Actual analysis of the work produced during the three months' period appears below.

TABLE 1

*I	Flats and small billets—type A furnace	11,800 hours
II	Flats and small billets—type B furnace	400 hours
III	Extrusion—Large, type A furnace	1,800 hours
IV	Extrusion—Large, type B furnace	3,500 hours
V	Shells, type A	2,000 hours
VI	Rods, type C	2,500 hours
	Total	22,000

* The six furnace-hour rates will be referred to hereafter by these numerals.

This total of 22,000 hours was corrected to 30,000 hours to obtain the normal production in order that the relationship between the various shapes, as indicated by the hours during which they occupied the furnaces during the test period, would be maintained. By dividing the total hours of each shape—(corrected to the 30,000 hours total)—by the possible operating hours for one furnace, the average number of furnaces used per shape during the test period was obtained. This figure was the first factor required in determining direct labor.

The number of casters and moldmen required to pour each shape which was definitely known, was expressed as a relative. By multiplying the average number of furnaces poured during the period by the labor factor per furnace, a direct labor factor per furnace per shape was obtained. It should be noted that this new factor, although called the direct-labor factor, took into account the type of furnace, the shape, and the labor. Six of these factors were determined; which will be known hereafter as direct labor factors. The direct labor payroll for the test period was apportioned to the six furnace-hour rates according to the direct-labor factor. The indirect labor payroll was handled in the same manner.

[1] TABLE 2—LABOR FACTOR

Rate	(a) Average Number of Casters per Furnace	(b) Average Number of Moldmen per Furnace	(c) (a) + (b)	(d) Relative Number of Men per Furnace	(e) Average Number of Furnaces Used at One Time	(f) (d) × (e) Labor Factor	(g) (f) Expressed as Percentages
I	1	1⅓	14/6	14	7	98	36.76%
II	2	2	24/6	24	1	24	9.00
III	1	⅔	10/6	10	2½	25	9.36
IV	2	1	18/6	18	3	54	20.18
V	1	1½	15/6	15	2	30	11.20
VI	2	2	24/6	24	1½	36	13.50
						267	100.00%

Note: To get direct-labor hourly rate for Number I

Labor factor (I), times total payroll for test period equals amount to be absorbed by (I), divided by number of hours actually operated on I gives hourly rate thus: $36.76\% \times \frac{\$19,300}{11,800} = .60c$. Indirect labor for I obtained in similar fashion: $36.76\% \times \frac{\$8,300}{11,800} = .26c$.

Supplies. Oil used in the molds, which was the only large item, was apportioned separately. Records were kept for the three months' period showing the number of gallons used for the different kinds of molds. The total expenditure for oil was increased to cover normal production, and was apportioned among the six rates on a basis of the results of the actual observations for the three months' period. All other supplies were grouped and apportioned to the various rates on a basis of the direct-labor factor.[2]

TABLE 3—OIL DISTRIBUTION

I and II	Flats and small billets	77%
III and IV	Extrusion	7%
V	Shells	10%
VI	Rods	6%

[1] *See* page 233, Table 6. [2] *See* page 233, Table 6.

General Mill Expense. This item, which included such accounts as works accounting, engineering, manager's office, employment, supplies, stores, and yard service, was distributed on the basis of the direct-labor factor after being increased to normal according to the judgment of the men in charge of the departments incurring the expense.[1]

Maintenance and Repairs. Analysis of past records showed the type C furnace to be directly responsible for 40% of the cost of maintenance and repairs, because this type was operated at a higher temperature than type A or B. These costs were increased to provide for normal production and applied to the rate for type C furnaces. The balance of the maintenance and repairs costs was spread over the rates, including the type C rates on the basis of the direct-labor factor.

Machine Depreciation. The ratio of original cost of types A, B, and C furnaces was 1 to 2 to 6. The factor representing the relative number of hours each type of furnace would operate to produce normal production was multiplied by this factor of original value, in order to obtain a new factor on the basis of which the total amount of depreciation determined by the directors was apportioned to the various furnace-hour rates. This new addition to the rate took into consideration three elements: number of furnaces in use at a time; the original value; and total hours operated during the test period.

TABLE 4—FURNACE FACTOR

	(a)	(b)	(c)	(d)	(e)	(f)
Type	Average Number of Furnaces in Use at a Time	Relative Original Value	Furnace Factor (a) × (b)	(c) on Percentage Basis	Total Hours Operated by Type	Hourly Depreciation Charge (d) × $1500 / (e)
	(from Table 2)				(from Table 1)	
A	7 + 2.5 + 2 = 11.5	1	11.5	40.6%	15,600	$0.039
B	1 + 3 = 4	2	8.0	27.7	3,900	.108
C	1.5	6	9.0	31.7	2,500	.190
			28.5	100.0%		

[1] Computed exactly as direct and indirect labor.

Metal Stores. The metal stores department receives both old scrap and virgin metal, which it weighs into boxes or batches of the desired quantity. The output of the metal stores department, is, therefore, measured by boxes. Since a mixture containing more ingredients requires more labor in weighing out the batches, the relation between the scale-man-hours and the furnace-hours for the different shapes was established during the test period by time studies. Inasmuch as the same shapes generally take the same mixtures, the number of scale-man-hours per shape for normal production was established. The total cost of metal stores was therefore distributed to shapes on that basis, divided by the normal furnace-hours per shape to give an hourly rate.

[1] TABLE 5—METAL STORES DISTRIBUTION

	(a)	(b)	(c)	(d)	(e)	(f)
Rate	Scale-Man-Hours per Furnace-Hour	Furnace-Hours	(a) × (b)	(c) on Percentage Basis	Share of Metal Stores Cost (d) × $19,000	Per Hour Charge (e) ÷ (b)
I & II	0.3	11,800 + 400	3,660	38.0%	$7,220	$0.59
III & IV	0.4	1,800 + 3,500	2,120	22.0	4,180	0.79
V	0.3	2,000	600	6.2	1,180	0.59
VI	1.3	2,500	3,250	33.8	6,420	2.56
			9,630	100.0%		

Cores—For Shell Casting Only. Raw materials for cores were figured at standard rates. The total direct labor for the test period divided by the core production, minus a 5% allowance for breakage, gave the direct-labor cost per core. Six thousand cores were assumed to be a normal production for three months. The total core room rent was divided by this figure, in order to secure a per core charge, which was added to the labor cost per core. Depreciation, power, light, heat, and other overhead charges in the core room, were reduced to a per-core basis. The total per-core cost was then transformed into an

[1] *See* page 233, Table 6.

hourly charge by multiplying by the normal number of cores used per hour. This hourly charge was added to the furnace-hour rate for Type A furnace when casting shells. This was the only rate affected by core charges.

Recapitulation. The final furnace-hour rates, of which there were six, consisted of 11 parts. It will be noted that the general method of determining the rates was to assume an arbitrary figure of normal production, and to determine all charges on that basis. One advantage claimed for this method is that any change in an individual element, such as labor, or rent, can be readily incorporated into the rate without affecting other elements.

TABLE 6

Item	I	II	III	IV	V	VI
Rent	$0.112	$ 0.112	$0.112	$0.112	$0.112	$0.112
Fuel	0.610	0.910	0.610	0.910	0.610	1.350
Relining and Repairing	0.125	0.175	0.125	0.175	0.125	1.100
Direct Labor	0.600	4.350	1.000	1.110	1.080	1.040
Indirect Labor	0.260	1.870	0.431	0.478	0.465	0.450
Supplies, Oil	0.126	0.126	0.026	0.026	0.100	0.048
Other	0.218	1.940	0.364	0.405	0.392	0.378
General Mill Expense	0.450	3.260	0.755	0.835	0.812	0.430
Maintenance and Repairs	0.265	1.910	0.442	0.490	0.475	0.468
Extra Repairs						1.200
Depreciation	0.039	0.108	0.039	0.108	0.039	0.190
Metal Stores	0.590	0.590	0.790	0.790	0.590	2.560
Cores					0.185	
Total	$3.395	$15.351	$4.694	$5.439	$4.985	$9.326

TABLE 7—TOTAL COST FOR TEST PERIOD OF VARIOUS FACTORS

Item	Amount	Basis of Distribution
Direct Labor	$19,300	Labor factor
Indirect Labor	8,300	Labor factor
Supplies, Oil	2,000	See Table 3
Supplies, Other	7,000	Labor factor
General Mill Expense	14,000	Labor factor
Maintenance and Repairs	8,500	Labor factor
Depreciation	1,500	Furnace factor
Metal Stores	19,000	See Table 5

12. RED METAL MANUFACTURING COMPANY—SECTION C—DISTRIBUTION OF OVERHEAD IN FABRICATING DIVISION ONLY

In the fabricating division of the Red Metal Manufacturing Company overhead was distributed to departments by the following method: Indirect labor and supplies were charged directly to the department from labor tickets and requisitions. Rent for the whole plant was divided by the total floor space, and the square-foot rate applied to all departments; unused ground was ignored. All other charges were grouped into a general overhead account which was distributed to departments in proportion to their direct-labor payroll. The system resulted in large balances of over- and under-absorbed burden, and was believed by the management to be so inexact as to nullify many of the attempts at detailed recording of the more direct items of expense.

The following system in use in another plant was submitted to the comptroller. A normal production for each of the 100 items manufactured [1] was established by discovering the point in the process which had the smallest capacity. This was usually found to be the finishing or assembly department. The greatest possible production of this department operating in regular hours was determined by a study of past records and by consultation with the foreman. Ninety per cent of this was assumed to be normal production to allow for any small necessary interruptions (for the article in question), and the production for all contributing departments was determined in physical units on this basis.

Overhead was divided as follows:

1. Indirect labor, supplies, and direct cost of repairs to machines (Usually done by the service departments)
2. Service department overhead and all other charges not directly applied against productive departments for services rendered
3. Depreciation on equipment
4. Rent

An estimate was obtained from each foreman of the percentage relation between item Number 1 which constituted the old

[1] Many items differed so little that grouping was possible, reducing the actual number of items treated in the manner described to about thirty.

departmental overhead and direct-labor payroll. This estimate was checked by analysis of actual figures for the first six months of 1922, increased to approximate the assumed normal production.

These percentages were then transformed into dollars and cents items, using the wage rates in force in early 1922 to determine the direct-labor figure. The first element of the overhead was thus established for each department.

Service Departments. The head of each service department was given a statement of his costs for the first six months of 1922, and asked to estimate the necessary increase in costs to bring all lines to the assumed normal production. For example, the works manager's office expended $1,800 a month during the first part of 1922. He estimated an additional $200 a month would be required to care for a 40% increase in production; making his new budget $2,000 a month. Each service department submitted a new estimate with cost of operation based on normal production. In cases such as the tool department, where most products were charged directly against departments, these charges were deducted from the total operating costs in the first half of 1922 and the balance alone was dealt with as described.

These estimated expenses were apportioned as dollars and cents amounts against the productive departments on the following bases:

Works Manager's Office—Direct labor
Estimating—Direct labor
General Works Manager—Direct labor
Works Accounting—Analysis of clerks' work
Purchasing—Number purchase orders handled
Rates and Labor—Number employees per department
General Supply Stores—Number requisitions issued
Plant Maintenance Dept.—Basis of direct-maintenance charges to department
Tool Dept.—Basis of direct-tool charges to department
Power, Heat, and Light—Engineering estimate
Yard—Productive labor
Trucking, Teaming, and Traffic—Estimate of head of department (Based on tons shipped)
Tool Drafting—Actual charges to departments
Miscellaneous Shipping—Productive labor

Interdepartmental Trucking—Estimate of head of department
Laboratory—(Research and Routine)—Estimate of head
Workmen's Compensation—Payroll
Group Insurance—Number employees

At all stages in the computations, although dollars and cents were accumulated to get the gross figure, distributions were translated into terms of percentage for future use. For example, the total works manager's expenses based on normal production would be distributed to the productive departments as dollars and cents amounts to accumulate the normal rate, but that distribution would be represented as percentages of the total works manager's expense.

Depreciation on Equipment. The policy determined by the directors has required a certain percentage of the original cost of all equipment and machinery to be written off each year. The total amount represented by this percentage on an appraisal made in 1922 was taken as the depreciation charge to be included in overhead. This total was divided among departments in proportion to the value of equipment in the department as shown by the appraisal. This third item was included in departmental overhead as a dollars and cents amount.

Rent. It was decided that rent should include the following four items: Taxes on buildings, machinery, and inventory; depreciation on buildings; insurance on buildings, machinery, and inventory; and maintenance of buildings. A schedule was drawn up showing the following information for each building in the fabricating division:

1. Present depreciated value as shown by appraisal.
2. Proportionate value of land. All land was considered as of the same value based on appraisal. Alleys and unoccupied areas were distributed to buildings in proportion to the actual area covered by the buildings.
3. Total value of all land and buildings = (1) + (2).
4. Taxes on land and buildings. Applied on the basis of (3).
5. Depreciation on buildings applied in accordance with the directors' policy on basis of (1).
6. Insurance on buildings applied on basis of (1).
7. Maintenance and repairs on buildings should be applied on the basis of past experience, but because of the absence of detailed past records of expenditures, the total item was distributed on a basis of floor area, weighted to make allowances for any special circumstances.

For example, one department in which acid was used required a special floor and frequent replacements because of the action of the acid. Other departments had specially heavy trucking which wore the floors faster.

Rent, exclusive of taxes and insurance on machinery and inventory = (4) + (5) + (6) + (7). This figure was now available for each building. It was next necessary to discover the part of the various buildings occupied by each department. A schedule,[1] therefore, was prepared showing for each building the actual square feet occupied by the departments it housed. These areas were weighted according to location on the basis of a schedule prepared by the engineers, which gave relative values for the various floors based on the first floor being equal to 100, which showed the basement to be equal to 50, the second, third, and fourth floors worth 85, and the fifth floor worth 80. These percentages varied somewhat for different buildings, but by multiplying the actual areas by these factors, all floor space in a given building was put on a comparable basis. The total of the weighted areas for each building was divided into the total rent value of the building, as shown in the first schedule, giving a square-foot rate for that building. By use of these rent rates and the area schedules for the various departments, a dollars and cents rent charge for each department based on the space actually occupied was obtained.

A second schedule was then drawn up showing the following items for each department:

1. Rent, obtained as above
2. Depreciated value of equipment as determined by the appraisal
3. Value of inventory determined by inventory records of the first of the year
4. Ratio of (2)÷(3)
5. Tax on equipment, determined by first splitting the total tax on equipment and inventory in proportion to the total value of each, and then apportioning the tax on equipment among departments in proportion to the appraised value as shown in (2)

[1] This schedule listed the buildings down the left-hand edge of the paper and provided columns for the following data: (1) floor number; (2) department number; (3) dimensions; (4) area; (5) use; (6) factor for weighting; (7) weighted area; (8) total weighted area for each building; (9) weighted square-foot-rent rate for each building; (10) departmental charges.

Of course, the same department might occupy several floors of the same building, or different buildings. Eventually all these items chargeable to the same department must be collected by a separate schedule to insert in column (1) of schedule two.

6. Tax on inventory, obtained in a similar manner based on item (3)
7. Insurance on machinery distributed on a basis of (2)
8. Insurance on inventory based on (3)
9. (5)+(6)+(7)+(8), or the total of the taxes and insurance on machinery and inventory, apportioned to departments on a basis of the value of machinery and inventory in the department
10. (9)+(1), or the total yearly rent figure was then divided by 12 to give a monthly figure

These dollars and cents rent charges to departments were added to other dollars and cents items already described, and the total figure related to the direct-labor figure for normal production in each department, giving a percentage to be used in applying overhead to product in each department.

The comptroller questioned some of the methods employed in the new system of applying overhead, as follows: The estimate of department managers as to percentage of present overhead to direct labor was checked only by the first six months of 1922 experience. He suggested that this check should be supported by an examination of a longer period of past experience. Similarly, in the estimates of the service department heads as to the increased cost of their departments for handling normal production, he maintained that a longer study might reveal a greater increase of the ratio when production was above normal than when below, inasmuch as periods of excessive production were usually periods of general inflation and labor inefficiency. The comptroller suggested that some provision should be made to care for such periods of inflation. Power, light, and heat service departments were distributed to productive departments, based on an engineering estimate. The power consumption was likely to vary considerably in cases where the operation of some large machine might be intermittent. The power item alone ran into a total of about $10,000 a month, and the comptroller believed that the distribution of such an important item should be more flexible to meet variations in conditions assumed to be normal. He suggested that this department should be distributed first on a basis of metered power, and only residue and overhead should be distributed on the basis of a standing estimate. In other words, the department should be handled in a manner similar to the plant maintenance department.

The whole depreciation schedule was dependent upon a policy of the board of directors which was subject to change at any

time. Engineering practice had established a desirable rate for depreciating various types of machinery. The comptroller suggested that the life history of each machine should be kept on a card and the original cost written off at a rate designated by engineers. The total depreciation figure for a department then would be obtained by adding the dollars and cents amounts to be written from each machine, and the amount would be changed from year to year only as new machines were added or old machines discarded. Under the former practice, when a machine was discarded its depreciated value could be determined only by reducing the original cost by the blanket rate at which all equipment had been depreciated.

Rent. The idea of including taxes and insurance on machinery and inventory in the rent item raised an objection until the works accountant explained that although these items were included in rent for convenience, they were not in any sense distributed on a square foot basis. The comptroller agreed that their basis of distribution on value of machinery and inventory was equitable, but suggested that the practice of including them in rent might cause confusion and criticism in the minds of others as it had in his own. In regard to the question of weighting the area occupied by a department, the comptroller suggested that the adaptability of the space should be considered. He cited an instance where a light, airy cement cellar was used for storing material which could be stored as well in the open air or in a dark and damp place. He contended that the supply stores department should not be penalized because of this superior storage space. The works accountant replied by asking the comptroller if he would charge a department situated in an inferior place a higher rate because of the greater use being made of that space. The comptroller admitted he would not do that. The former system did not take into consideration the adaptability, but merely evaluated the space on the basis of the kind of structure of which it was a part; hence a department situated in a new cement building would bear a heavier rent than one situated in an old wooden building, on the theory that it received benefit in operating efficiency from the improved location. The distribution of all land at the same rate was a basis of further discussion. Obviously, land situated on a back street was not as valuable as a frontage

on a main street or a railroad, yet the works accountant contended that for the purposes of the company as a going concern all land was equally necessary and accordingly of equal value.

Objection was raised in connection with the distribution to departments of maintenance and repairs of buildings, which was provided for on a weighted floor-area basis taking into account unusual circumstances. The comptroller recognized that this was the best possible method in the absence of detailed past records, and recommended that for several years, at least, all repair work on buildings should be recorded carefully in order that the responsibility of various departments might be determined. Obviously such ordinary repairs as painting or roofing would be cared for by the schedule and weighting for the different floors of a building already in use, but in the case of internal repairs the nature of the work done in a department has a direct effect.

Depreciation on buildings was provided on the basis of valuation, but the comptroller suggested that in this case as in the case of maintenance and repairs, the nature of the work done in the building would have a direct effect upon its life, regardless of its original value. He recommended that an engineering rate of depreciation for machines should be substituted for the directors' policy at the earliest possible moment.

Should the proposed method of handling overhead have been adopted? If so, what modifications should have been made?

13. FAIRFAX WIRE COMPANY—CHANGE IN METHOD OF DISTRIBUTING BURDEN FOR COST FINDING

The Fairfax Wire Company manufactured a wide variety of insulated wire products ranging from the smallest size of finished wire to large armored cables for submarine electrical communication. A method of distributing burden charges for the purpose of cost finding had been worked out with the growth of the company. The executives believed, however, that some other method of burden distribution should be developed.

Production was carried on in a modern, well-equipped factory where normally there were about 500 employees. The average daily output of wire of all types was between 1,500,000 and 2,000,000 linear feet. The sales and administrative offices were located in a separate building in the business section of a large city several miles from the factory.

There were two general production departments, each under a superintendent. The Rubber Department was subdivided as follows: Rubber Compounds; Insulating; Vulcanizing; Testing; Twisting and Stranding; Armoring; Tinning; and Lead. The Weather-proof Department was subdivided into Braiding and Spooling, Saturating, and Wax Finishing. At the head of each subdivision was a foreman, and each subdivision occupied one or more separate rooms in the factory.

Raw materials used in production consisted chiefly of copper and copper wire, lead, cotton, rubber, steel tape, armored wire, and chemicals. Upon receipt at the factory, materials were checked against the invoices and sent to the departments in which they were to be used. If the bulk of the materials prohibited their storage in the various departments, they were put in special storerooms. Regardless of their disposition, however, they were placed under the control of the division foreman who kept a perpetual inventory on bin cards of the quantity of all materials in the factory available for use in his division. As the materials were used they were deducted from the amount shown on the foremen's cards, but no records of the amounts used on individual jobs were kept for cost purposes.

Production was divided about equally between three general types of goods. The first type included all standard wires produced for stock. The second type consisted of wires produced over a period of time to fill large orders for which formal contracts had been made with the buyers. The third general type included all kinds of special order work where specifications other than the stock standards were called for by the buyer.

In distributing burden and in finding costs, no attempt was made to allocate costs to individual jobs or orders. When orders were received at the sales office, a quotation immediately was supplied to the customer by the estimating department. If the quotation was accepted, an order was given to the factory to deliver or manufacture the goods called for, and no further provisions were made at any point to check the costs. The quotation was built up from cost sheets supplied to the estimating department by the factory superintendent.

These costs were worked out by three cost men under the supervision of the factory superintendent. Their method was to study every manufacturing process in the factory, and to

determine for each separate process the amount of material required and the direct-labor expense involved. In this manner a schedule was worked out to show the cost per 1,000 feet of every type of wire which would be put through each particular process. For each type going through a given process the quantities of various materials needed to produce a 1,000 feet unit was ascertained. In addition, the cost in dollars and cents of direct labor used in the process was figured out and included in the cost schedule. Thus, for every type of wire manufactured, it was possible to prepare a cost sheet showing the amount of materials to be used in every manufacturing process and the value of direct labor used on each process. Checks were made regularly to insure the accuracy of the cost sheets.

In order to make its quotation, the estimating department secured from the sheet describing the wire desired the amount of each kind of raw material required in each process and the direct-labor cost. The purchasing department supplied the estimating department weekly with a sheet indicating the price at which each kind of material was to be charged during the following week. The price figure was determined from current market prices plus a small percentage for incoming transportation and incidental charges.

Occasionally a type of wire was ordered which had never before been manufactured. In this case the factory superintendent was called upon to submit a new cost sheet which was made up by approximating the cost of materials and the processes through which the new type would be run.

Practically all the manufacturing processes in the production of insulated wire were carried on by machines which varied in size, from large types costing thousands of dollars each to small braiding and twisting machines. Some departments had two or three large machines, whereas others had as many as 2,000 small machines. On a few of the large machines a single-machine rate was used to distribute burden. This rate was used to apply only on running time, since idle time and setting-up time were included in the overhead charges.

In general, however, the burden was distributed as a percentage of direct-labor costs. In each factory division the charges for indirect labor, interest, insurance, depreciation, repairs, heat, light, power, and incidentals were totaled for a

period of one year, and this total was expressed in a percentage of the direct-labor charges for the year. The percentage of divisional overhead was included in the cost sheets for use in making quotations. General factory overhead, which could not be applied to specific factory divisions, likewise was figured for a period of a year and shown as a percentage of the total direct-labor charges of the entire plant.

After having arrived at the cost for material and labor charges on a given order, the estimating department added, as a proportion of the direct-labor charges, a percentage for divisional overhead and a further percentage for general factory overhead.

Administrative and sales expense were distributed as a percentage of the combined raw material and direct-labor costs of the year's output. To arrive at the amount to be included in the quotation for administrative and sales overhead, it was necessary, therefore, to combine the cost of raw material and the direct-labor costs for the particular job.

The total of these various amounts as figured by the estimating department furnished the cost of a particular order. The amount to be added for profit varied with general business conditions and the market for the company's product.

The Fairfax Wire Company decided that it was not advisable or necessary to install a system of costs which would allocate individual costs to specific orders. The nature of the processes was such that the amount of each material required for each process could be figured definitely, and there would be no subsequent variation after the amount had been determined. Careful checks were kept on production to insure the use of the correct amount of material in each process. These checks were made from a production standpoint rather than one of cost finding.

The company realized that distributing factory overhead on the basis of direct-labor charges for a particular process did not discriminate between the expenses of operating machines of different sizes which required varying amounts of power, space, and repairs, since the same amount of direct labor might be required for entirely different types of machines.

It was desired, therefore, that a more equitable division of overhead be made without changing the general method of finding costs for quotation purposes.

What plan should have been proposed to bring about the desired results?

14. FEATURE FILM COMPANY—ALLOCATION OF BURDEN

Until 1923 executive emphasis in the Feature Film Company had been directed upon development and expansion problems. Although the company had become one of the largest producers in the motion picture industry, accurate determination of costs for each production had never been attempted. The company had followed the policy of charging directly to a production the costs of costumes, props, sets, and scenario, or salaries of story writers. Salaries of stars, talent,[1] and directors, administrative costs, and location costs were lumped into overhead and distributed by dividing by the number of pictures produced. Consequently 70% of total costs were considered overhead.

The basis of a picture is a play, a book, or a new scenario. Rights to use a play or book are purchased, while a scenario is bought outright. If a play or a book is used, it is necessary to change the technique on account of the limitations of photographic effect. The picture must have action. A corps of scenario writers, therefore, go over the book and cull out all descriptive and discursive passages which do not contribute to the movement of the story. Often in the adaptation of a legitimate play to the screen, revision is necessary.

The production manager next selects the star, and together they choose the director. The director occupies a unique position somewhat similar to that of a special consulting engineer who supervises a construction job. After the selection of the star and the director, the home office delegates authority to the star and director to pick the remainder of the cast. In some instances the director employs the camera men. The director and the scenario writer or author then map out the procedure for taking the story, and the art director consults with the drafting department on his needs for special sets or props. It is generally necessary to construct the sets for each picture. Blueprints are made of the proposed sets, and after approval by the director they are sent to the carpenters to be constructed.

[1] Talent is the term commonly used in the film business to include that group of players next below the stars. The talent play parts requiring dramatic ability; and they hope to become stars.

If the picture requires any outside scenes or locations, they are found by men employed for that purpose. If a street scene is wanted, the only expense is that of finding the most suitable location. If requirements demand a large ball room or estate, arrangements of a financial nature with the owner have to be made.

Pictures are not made in chronological order. Scenes for one picture may be laid in New York and Palm Beach and the story may shift locations at different times. Pictures are taken in New York of all scenes to be enacted there, and then the company goes to Palm Beach for all scenes at that location.

Every night the films taken during the day are developed, and the star goes over the results before starting the next day's work. If any scenes have turned out badly, they are retaken the first thing on the following day. While the picture is being taken the same scene may be shot a great many times in order to get the desired effect. As a usual thing, 6,000 feet of finished film, which is the length of the ordinary six-reel picture, requires exposure of from 30,000 to 50,000 feet of film during production.

Wardrobes are rented or bought. In some instances, however, a substantial portion of modern apparel is furnished by the actors. Period costumes or uniforms are rented whenever possible. Sometimes it is possible to use costumes for later productions, in which cases they are stored. If it is believed unlikely that further use will be had for the costumes, they are sold. In the same way furniture and rugs are rented whenever possible.

The Feature Film Company has four studios, one in the East and three in the West. At each studio from one to six productions are always in process. Some of the productions require much more studio space than others. This usually depends upon the elaborateness of the sets and the length of time required to erect them. To expedite production, sets are erected before they are needed. Some pictures are taken entirely out of doors. Those taken in the studio require a great amount of electricity.

Overhead items include rent, insurance, heat, light, and depreciation. They also include portions of the salaries of stars, directors, and talent actors who take lesser leads which cannot be charged directly to production. It is customary for a star to make a picture and then rest for two or three weeks. During this time he, as well as the director, and talent, is paid a retaining

salary. There are also certain indirect expenses of carpenter and scenic salaries. Generally the indirect expense is from 15% to 20% of the cost of a production.

The practices of other large companies in the distribution of burden varied. One of the most common methods was to distribute overhead on a camera-day basis. By this method overhead was figured weekly, and apportioned to the productions which had been worked on during the week. For example, if three productions were in process, and one had been photographed on four days, another on six days, and the last on two days, the proportion of overhead borne by the first would be one-third, by the second one-half, and by the third one-sixth. Another method, which was of more recent origin, was that of allocating on the basis of floor space used in the studio. The Feature studios were already blocked off into sections, which would make it easy to figure the proportion of space used by each set. A third method distributed burden on a percentage of direct cost. If during one month two productions were made, one costing $200,000 and the other $400,000, the first would bear one-third and the second two-thirds of the overhead for the period. A modification of this plan was used by one company. Distribution of overhead was on a percentage of direct cost, with the salary of the star and the cost of the story deducted from the direct cost.

Which method should the Feature Film Company use in distributing burden in its new accounting system?

15. THE DEXTER MACHINERY COMPANY—ACCOUNTING FOR IDLE TIME

The Dexter Machinery Company distributes its departmental burden to its products on a productive-hour basis, and charges off any unabsorbed or overabsorbed burden directly to Profit and Loss at the end of each fiscal period. This method of handling burden is not satisfactory to the management because it does not throw sufficient emphasis on the condition of burden absorption and the facts underlying it. The management is, therefore, desirous of changing its method.

In August, 1922, the overhead expenses in Department B amounted to $9,733.83 and the labor-hours of the direct workmen totaled 5,867. The productive-hour rate for overhead in

this department for the month was, therefore, $1.68. From January, 1921, to August, 1922, the monthly rate has been

1921		1922	
January	$1.24	January	$1.88
February	1.37	February	1.83
March	1.45	March	1.78
April	1.56	April	1.85
May	1.67	May	1.88
June	2.03	June	2.00
July	2.23	July	1.83
August	2.17	August	1.68
September	2.10		
October	2.08		
November	1.98		
December	1.94		

The rate of January, 1921, $1.24, approximates the average rate incurred by the company in normal times. This rate is used in charging overhead to jobs, so that the product may be priced low enough to meet competition, while unabsorbed overhead is charged off directly to Profit and Loss.

The actual productive-hour rates for overhead furnish an index of the disadvantages arising from low production. They show that production in Department B evidently reached its lowest point in July, 1921, and that the output has been gradually increasing since that time with the exception of a short period of the spring of 1922. It would be advisable, however, to show more concisely the state of production of the plant as a whole.

The Pierce and Jones Electric Company has followed the practice of bringing all burden under- or over-absorbed at the end of each period into an account called "Burden Reserve" which is never closed out. Like the Dexter Company, it uses a normal rate to distribute the burden to jobs in each department. It is planned that in prosperous times burden shall be overabsorbed so that a reserve will be built up to take care of the unabsorbed burden in times of depression. It is hoped that the "Burden Reserve" account will balance over a business cycle. The changes in the balance of this account should, it is claimed, indicate whether business is normal, in which case practically no balance should remain to be charged by a department into "Burden Reserve," or whether the company's business is relatively good or bad, in which cases respectively an overabsorbed

or an underabsorbed amount will require closing out. This index will enable the company to compare the present state of its business with average conditions.

Should the Dexter Machinery Company introduce the Pierce and Jones Electric Company's method?

If the Pierce and Jones method is introduced, and at the close of any fiscal period the account shows a debit balance, should this balance be carried as a deferred asset on the balance sheet as is the practice of the Pierce and Jones Company, or what disposal should be made of it?

16. THE LOTUS BOTTLING COMPANY—TREATMENT OF IDLE TIME

The greatest individual problem in accounting for the manufacture of soft drinks arises from the waste resulting from idle machinery and idle workers during certain months of the year. The situation in the plant of the Lotus Bottling Company is typical of the industry as a whole, and is best represented by the following table of production[1] during 1921:

Months	Quarts	Pints	Splits	Days Operated	Possible Operation	Days Idle Time
January	12,000	8,000	6,000	10	25	15
February	16,000	100	10,000	13	23	10
March	32,000	20,000	16,000	27	27	0
April	20,000	22,000	16,000	25	25	0
May	18,000	12,000	16,000	25	25	0
June	36,000	12,000	32,000	25	25	0
July	48,000	14,000	32,000	25	25	0
August	50,000	10,000	26,000	25	25	0
September	28,000	6,000	12,000	16	24	8
October	30,000	4,000	10,000	14	25	11
November	16,000	8,000	8,000	12	24	12
December	12,000	20,000	10,000	16	25	9
Totals	318,000	136,100	194,000	233	298	65

The selling season is concentrated almost entirely within the three months of June, July, and August, but it will be seen from the production figures that the manufacturing period may be spread over a somewhat larger portion of the year. It is not

[1] All figures are given in cases. Sizes are packed as follows: quarts, 12; pints, 24; and splits, 24 bottles per case.

possible to surmount the difficulty entirely by this means, however, owing to the fact that carbonized drinks deteriorate if kept in stock more than three months. Manufacturing may begin in March for the June sales. Conditions are such, therefore, that the idle time of 65 days per year—or 22% of the possible operating time—must be regarded as an inevitable loss. How shall this loss be shown in the costs of doing business? Shall the costs of soft drinks produced in January be considered to be nearly double the costs of the same products made in June just because the plant is idle for half of January?

The company's investment in fixed asse s consists of:

Machinery	$65,000
Building and Real Estate	75,000
Delivery Equipment	21,000
Total	$161,000

Fixed charges of the plant include depreciation, taxes, insurance, and according to some authorities, interest on this investment in fixed assets. On the amounts of these items of expense there is practically no difference between busy and idle months. Another group of expense includes light, power, fuel, factory supplies, supervision, spoilage, breakage, and miscellaneous expense. These items will diminish somewhat during slack periods, but not in proportion to the idle time. A third class of expense —and one which is affected by these conditions—is the direct labor which must be maintained during idle periods in order to have them available during the busy season. The mechanical equipment consists almost entirely of two large bottling machines, the handling of which calls for a degree of skill which cannot be rapidly acquired. During idle periods the men can be assigned to odd jobs about the factory which have to be done sometime, but the possibilities in this direction do not nearly absorb the amount of idle payroll.

In giving consideration to this matter the Cost Accounting Department of the Lotus Bottling Company has made a study of authoritative opinions available. They have noted the views of Mr. A. Hamilton Church to the effect that unabsorbed expense arising from idleness may be added to the costs of the product by means of a supplementary rate.[1] Mr. Church recognizes

[1] Church, A. H., *Expense Burden*, pp. 66 and 69.
"The meaning of the term supplementary rate will now be understood. It is

two cases: 1. Where the machine is seldom used but is essential to the general manufacturing processes; 2. Where the machine is kept as an accommodation or non-essential convenience. In a later work he seems to put the emphasis in a different place.[1] This later view is held also by Mr. H. L. Gantt[2] and by Mr. C. H. Scovell[3]—though the latter makes an exception of the case where the idleness is due to enforced seasonal variation.

How should the question of idle time be dealt with in the accounts of the Lotus Bottling Company in order to give the most reliable data about production costs?

17. THE POPHAM CEREAL COMPANY—STANDARD COSTS AND SEASONAL VARIATIONS IN OUTPUT

Instead of making each month bear the actual expense of heat-

this which is the invaluable complement to the machine-rate and which makes the great distinction between the new method and the old machine-rate method. *The supplementary rate is the undistributed balance of shop charges due to idleness of productive centers.*

"Then, as each machine is occupied on jobs, the latter are debited with so much per hour as machine-rate, and at the end of the month the total amount so earned by the machines *is deducted from the total shop expenses,* leaving a balance which is distributed over the same jobs as a *supplementary rate.* The ratio of the supplementary rate to the amount distributed by the machine-rates forms a varying barometer, whose fluctuation is an index to the current efficiency of the shop."

[1] Church, A. H., *Manufacturing Costs and Accounts,* p. 71. McGraw-Hill Book Co., New York City.

"Both these latter cases are similar in effect. *They imply wasted opportunities.* But neglect or inability to employ opportunity to the full should not be visited on the work actually performed. In other words, *the cost of idle machines should be separated from the process-cost of work.*"

[2] Gantt, H. L., *Proceedings of the American Society of Mechanical Engineers,* 1915, Vol. XXXVII, pp. 109-128.

"The indirect expense chargeable to the output of the factory should bear the same ratio to the indirect expense necessary to run the factory at the normal capacity, as the output in question bears to the normal output of the factory.

"Under this method of distributing expense there will be a certain amount of undistributed expense remaining, whenever the factory runs below the normal output or capacity. A careful consideration of this item will show that it is not chargeable to the product made, but is a business expense incurred on account of our maintaining a certain portion of the factory idle, and charged to Loss and Gain.

"The view of costs so largely held, namely that the product of a factory, however small, must bear the total expense, however large, is responsible for much of the confusion about costs, and hence leads to unsound business policies. As a matter of fact, it seems that the attempt to make a product bear the expense not needed for its production is one of the most serious defects in our industrial system today, and farther reaching than the differences between employer and employee."

[3] Scovell, C. H., *Cost Accounting and Burden Application,* pp. 236-237.

ing and lighting the factory, the Popham Cereal Company proposes to charge each month with one-twelfth of the estimated cost for the year. The cost data of past years would be used as a basis for determining the monthly charge. This method would draw attention to inefficiencies and would simplify the accounting procedure. Manufacturing would be charged, and the heating and lighting expense accounts would be credited, with the standard rate at the end of each month. Actual expenditures for heating and lighting would be charged in the expense accounts at the time they were made. At the end of the year, the balances in these accounts would show the amount of over- or under-absorbed burden, and would be closed into Profit and Loss.

The Popham Company recently began to manufacture farina and rolled oats. Since both of these cereals require cooking, the sales are greater during the winter than during the summer. It is believed that the production curve will be leveled out by the manufacture of these cereals, because 57% of the prepared breakfast foods of the Popham Company are sold from May to August inclusive. Last year the sales of cereal and the cost of heating and lighting the plant were as follows:

Month	Sales in Million Cases of 36 Pkgs.	Heating Expense	Lighting Expense
January	.4	$2,020	$284
February	.3	1,900	280
March	.7	1,900	302
April	.9	750	276
May	1.6	560	223
June	2.1	...	112
July	1.8	...	118
August	1.3	...	108
September	1.0	440	123
October	.8	525	226
November	.5	1,200	287
December	.4	1,800	312

The management depends upon a comparison of the current monthly statements with those of the same month for previous years to guide it in making decisions. Because of the seasonal character of the sales, the monthly operating statements showed a loss during the winter months which was offset by a large

profit during May, June, and July. Two years ago, when it was proposed to charge heat and light at a standard rate each month, the management objected because the charging of heating and lighting expenses at a standard monthly rate would change the monthly profit and loss statement; would not show the actual conditions of operations; and would be misleading.

Should the management of the Popham Cereal Company charge heating and lighting expense to manufacturing at a standard monthly rate?

18. SWINFORD-EATON MANUFACTURING COMPANY—RESERVE FOR BURDEN CHARGES

The Swinford-Eaton Manufacturing Company makes small tools, small machine tools, taps, and dies largely for sale to industrial users. Costs are kept for each individual article manufactured. Each department is separated into several production centers, and burden is distributed to each of these centers on the basis of man-hours. Under the conditions of normal operation, which the company considers as 90% of capacity, the burden charge for each man-hour is distributed for the current month on the basis of the actual cost of the preceding month. Variations between the charges made on the basis of this amount for each man-hour and the actual overhead to be distributed to that center are charged or credited directly to profit and loss. In 1921 subnormal demand in the industry kept production at about 50% of capacity. In determining costs under these conditions the company did not think it advisable to distribute the full burden to the cost of articles manufactured in its various departments, but chose rather to use for the amount of its burden charge a figure based upon costs of operation under normal production. The resulting difference between actual overhead cost and that charged to the product was charged to profit and loss.

In the summer of 1922 conditions in the industry had so improved that the actual burden could be distributed directly to product. It was suggested at this time that if conditions improved still further, the principle which had been applied in times of depression should be used also in periods of prosperity; in other words, that when production was above normal the normal burden charge should still be used in distributing overhead costs to

product, and the difference should be set up in a special reserve account for burden charges, out of which the losses might be taken when they occurred, instead of directly out of profit and loss. In this way the company would be able to determine whether or not, over a period of years, the overhead costs of the company were entirely taken up in the cost of manufacturing the product.

Against the establishment of this reserve, however, it was stated that competition in the industry, even in days of prosperity, would not permit selling prices based on this "normal" burden charge which would be above the actual current cost, and that, therefore, the selling price would show the company a smaller profit than would be obtained if actual burden charges were used, so that in effect the amount of the difference between the actual and the normal burden would be reflected in the profit and loss account as previously, though with a different influence.

Should the Swinford-Eaton Company have established a separate reserve for burden charges?

19. THE COVEL PAPER COMPANY—BURDEN DISTRIBUTION BY MACHINE RATE

The Covel Paper Company makes a special kind of paper, involving the use of large units of plant, the operating costs of which are very heavy. The company therefore attaches great importance to the calculations of the machine rates by which burden expense is allocated to the product. Moreover, the question of the correct interpretation to be placed upon overabsorbed and underabsorbed balances in the burden expense accounts has occasioned much dispute. It is therefore desired to compile the records dealing with this subject in the most accurate and reliable manner possible. The case of one machine is taken in order to bring out the questions involved.

Machine Number 8, by running day and night, has a full time capacity of 600 hours per month, and a normal operating capacity of 580 hours per month; in April, 1922, it actually ran 520 hours. The tables on page 254 show:

(a) The items of expense entering into the maintenance and operation of machine Number 8

(b) The average monthly amounts for each of these items, based on study of a considerable period

(c) The actual amount for each item, for the month of April, 1922

ITEMS WHICH ARE DEEMED TO VARY WITH PRODUCTION

(a)	(b) Average	(c) April, 1922
Indirect Labor	$450	$400
Machine and Miscellaneous Supplies	780	700
Water	135	120
Teaming and Yard Expense	560	500
Stock Handling	165	150
Repairs to Machinery, Labor	400	350
Repairs to Machinery, Material	280	250
Power and Light	4,000	3,618
Heat	370	330
	$7,140	$6,418

FIXED CHARGES

(a)	(b) Average	(c) April, 1922
Watchman	$ 68	$ 68
Fire Brigade	84	84
Taxes	630	630
Insurance	415	415
Depreciation	2,750	2,750
Building Repairs—Labor	395	395
Building Repairs—Materials	482	482
Supervision	200	200
Power and Light	518	518
Heat	237	237
Oiling and Cleaning	63	63
Stores—Raw Material	137	137
Stores—General	187	187
Accounting and Office	34	34
Plant Office	50	50
Laboratory	50	50
	$ 6,300	$ 6,300
Total Expense	$13,440	$12,718

Work out a machine rate which you consider to be appropriate for the distribution of burden to the product during the month of April.

Show the burden account in the cost ledger, for machine Number 8, for the month.

Analyze the balance of the burden account at the end of the months, to show what causes have produced it.

Describe the source from which each item in the list of expenses for machine Number 8 was derived.

Why do Power, Light, and Heat appear in the lists of both fixed and variable expenses?

What is the significance of the inclusion of charges for stores, stock handling and teaming in the list of burden expenses? By what other methods might they be disposed of?

How reliable do you consider the division of expenses into fixed and variable charges would probably be? What would be the effect of error in making this classification?

REFERENCES

BAILLET, H. F. *Overhead Expenses and Percentage Methods.* D. Williams Co., New York, 1915.

BOSTON, H. R. "Finding the 'Stop Loss' Price Point," *Industrial Management,* Nov., 1921, pp. 266-268.

CHURCH, A. HAMILTON. *The Proper Distribution of Expense Burden.* Engineering Magazine Co., New York, 1921.

FICKER, NICHOLAS THIEL. *Shop Expense Analysis and Control.* Industrial Management Co., New York, 1917.

GARRY, H. S. "Multiple Cost Accounts," *The Accountants' Library,* Vol. XLII.

HARRISON, G. CHARTER. "The Higher Cost of Idleness," *Management Engineering,* Aug., 1921, pp. 99-102.

MAIN, FRANK W. "Some Special Aspects of the Problem of Overhead Distribution and Application," *N. A. C. A. 1920 Year Book,* pp. 28-44.

O'HARA, J. J. "Industrial Depression and Cost Manipulation," *Administration,* May, 1922, pp. 545-558.

POLAKOV, WALTER H. "Distributing Overhead to Lower Sales Prices," *Factory,* April, 1922, pp. 400-402.

POPE, F. A. "Analysis and Control of Factory Transportation," *Factory,* Jan., 1922, p. 38.

SCOVELL, CLINTON H. *Cost Accounting and Burden Application,* Chapters VI to XIV.

STAUBACH, C. P. "Apportioning Sales Overhead," *Bulletin of Taylor Society,* Feb., 1922, pp. 27-33.

STELLING, P. "The Collection of Data for Ascertaining Overhead Expenses," *The Cost Accountant,* Nov., 1922, pp. 192-198.

TOWNSEND, R. "Factory Expenses in Theory and Practice," *The Cost Accountant,* Oct., 1922, pp. 155-159.

VANZANDT, CHARLES. "Normal Burden Rates," *N. A. C. A. Official Publications,* Vol. III, No. 19.

WILLIAMS, C. B. et alii "Distribution of Overhead Under Abnormal Conditions," *N. A. C. A. 1921 Year Book,* pp. 199-244.

WILMONT, H. "The Cost of Idleness and Its Relationship to the Predetermination of Costs," *The Cost Accountant*, May, 1922, pp. 254-255.

——— "Setting Machine Rates for Special Purpose Machines," *N. A. C. A. Bulletin, No. 8*, July 15, 1921, pp. 29-33.

——— "Cost of Idle or Unused Capacity," *N. A. C. A. Bulletin, No. 20*, Feb. 1, 1922, pp. 129-132.

V

BURDEN PROBLEMS WITH SPECIFIC ITEMS OF EXPENSE

A. DEPRECIATION AND DEPLETION

1. BELLOWS FALLS TOOL COMPANY—METHOD OF HANDLING DEPRECIATION

For the past 25 years the Bellows Falls Tool Company has followed the practice of carrying its capital equipment on its books at an exceedingly conservative figure. Each year an arbitrary figure for depreciation is charged, the size of the charge depending largely on the amount of the profits for that year. In 1916 each piece of equipment was carried on the books at the sum of $1.00. During the war, however, when several additions were made to plant and equipment, the management did not think it advisable to make such an arbitrary decrease on the new capital values immediately. The amount charged for depreciation has never been included in the cost figures kept by the company, but has been deducted from the Profit and Loss account at the end of the year.

At the time of the addition of the new plant and equipment, the president of the company had compiled for his own use an accurate statement of all buildings and machinery owned by the company with their original costs and present value. These figures have never entered the statement of the company in any way, being kept merely for reference. The assistant auditor has stated that the present method of charging depreciation serves no useful purpose, and has suggested that it would be advisable to use the list of machinery and equipment in the cost figures of the company as a basis for figuring more accurate depreciation.

Should this recommendation be adopted by the president of the Bellows Falls Tool Company?

2. THE HARPER CHEMICAL COMPANY—DEPRECIATION

The Harper Chemical Company has charged 5% of cost of buildings and 7½% of cost of plant and equipment to manufacturing cost yearly. Since large expenditures for repairs and maintenance are necessary because of the uncertainty of the effect of gases and acids on the equipment and buildings, these low rates of depreciation are possible.

In the muriatic acid department a large pan costing $3,000 has an average life of two years. In one instance a pan had to be replaced at the end of two weeks, although in another instance it lasted for a period of three years. In the first case, the pan was thoroughly inspected and no evidence of faulty material or workmanship could be detected either when it was installed or when it was removed. The company has always included the depreciation on this pan, which theoretically is 50% of its cost, in the 7½% applied on the departmental valuation and has charged the replacement cost to Maintenance. This practice has been followed because it is easy to operate and it avoids the detail connected with journal entries if the pan should last for a shorter or longer period. Inasmuch as there is some equipment in each department that depreciates slowly, and since depreciation is a departmental charge rather than a charge on individual equipment, 7½% has seemed to be equitable.

Repair operating charges are debited to Manufacturing and credited to Reserve for Repairs at a standard rate per month based largely on past experience. When the actual expenditures for repairs are made, Repair and Maintenance is debited. A monthly schedule of repairs is prepared showing the total expenditures made to date, expenditures made during the month, and the total standard allowance. At the end of each quarter, if the report shows that there tends to be a wide variation between the reserve set up and the actual expenditures, the standard is adjusted. In the last month of the year, a final adjustment is made so that these two accounts are always balanced when the books are closed. When too large a reserve has been set up a credit entry to Manufacturing is necessary.

In making its income-tax return, the Harper Company showed the replacement of the muriatic acid pan as a charge to Maintenance. The Internal Revenue Department ruled that the re-

placement of the pan was a capital charge and proceeded to make an adjustment of $3,000 in the returns. The company objected on the grounds that only 7½% depreciation had been charged and although the original cost debited to Maintenance should have been charged theoretically as Depreciation, the total depreciation and maintenance charges in a large plant would tend to be uniform from year to year. Furthermore, a possible understatement of profits during the year when the pan was replaced would be offset by an overstatement of profits in a year when this pan did not require replacement.

This illustration is more or less typical of what occurs in other departments, but the muriatic acid instance is outstanding because of the original cost of the pan. The Internal Revenue Department finally allowed the returns to stand as filed, but suggested that in the future the depreciation and maintenance charges should be accounted for with more accuracy.

Should the Harper Chemical Company change its accounting methods to comply with the suggestion of the Internal Revenue Department? If so, what changes should be made?

3. THE PELHAM ELECTRIC COMPANY—ACCOUNTING FOR DEPRECIATION

The Pelham Electric Company of Massachusetts has a fixed investment of approximately $5,000,000 in boilers, turbo-generators, condensers, and other equipment used in producing electricity. Because of the rapid improvement in electrical equipment it has been found in this business that obsolescence must usually be provided for rather than depreciation. The Pelham Company, however, is planning to put a large amount into an account called "Depreciation Reserve" every year that earnings permit, because there is no account for "Obsolescence" in the Uniform System of Accounts for Gas and Electric Companies, prescribed by the Massachusetts Department of Public Utilities beginning July 1, 1921. Last year the company had earnings of $953,226.58 before providing for depreciation. The board of directors has voted to set aside $500,000 to cover all depreciation. The company's auditor is undecided, however, as to what account should be charged because of the following provisions in the regulations governing the "Uniform System of Accounts."

E678. Depreciation

This account shall include monthly or periodic charges of the amount estimated to be necessary to provide for the retirement of property no longer used or useful in the conduct of the company's business, and for losses in value due to wear and tear not covered by current repairs.

The amount charged to this account shall be concurrently credited to Balance Sheet account No. 319, "Depreciation Reserve."

Note.—A Depreciation Reserve may be created either by charges made to Operating Expense account No. 678, "Depreciation," or to Profit and Loss account No. 415, "Appropriations of Surplus for Depreciation," or to both.

415. Appropriations of Surplus for Depreciation

This account shall include monthly or periodic charges of the amount estimated to be necessary to provide for the retirement of property no longer used or useful in the conduct of the company's business, and for losses in value due to wear and tear not covered by current repairs.

The amount charged to this account shall be concurrently credited to Balance Sheet account No. 319, "Depreciation Reserve."

Note.—A Depreciation Reserve may be created either by charges made to Profit and Loss account No. 415, "Appropriations of Surplus for Depreciation," or to Operating Expense account No. 678, "Depreciation," or to both.

4. THE CONSOLIDATED STREET RAILWAYS COMPANY—ACCOUNTING FOR DEPRECIATION

The Board of Public Trustees appointed to operate the Consolidated Street Railways Company has established fares sufficient to meet operating expenses, current depreciation, replacements, and rehabilitation, and also gradually to wipe out the deficit arising through the disposal of obsolete and useless cars. These charges are all treated as expenses of operation. The stockholders are agitating to have part of this money paid to them in dividends, instead of putting it all into equipment, because the Public Trustees have been unable to pay the 6% dividends that it was hoped they would be able to meet regularly.

The Consolidated Street Railways Company was formed by the consolidation of 72 different companies. At the time of the consolidation the volume of business was considerably greater than it is now, although the 5-cent fares then prevalent were lower than the average fare now in effect, for about 1910 com-

petition from automobiles began to reduce the company's business. By 1918, it was estimated that 70% of the houses on the company's rural lines had garages. At that time from 1,500 to 1,600 cars were necessary to do a yearly gross business of $7,000,000.

In the past many of the cars were of the open variety, and motors were transferred, with the change of season, from open to closed cars and vice versa at an approximate cost of $50 for each transfer. It was estimated that by this plan one and one-half cars were kept on hand to do work which might have been done by one car. Operating expenses were, therefore, high. The advent of the automobile and the conditions brought about by the war caused the company's park business to fall off to such an extent that it became advisable to sell the park property held by the company. Since riding on the cars was no longer a pleasure but rather a necessity, the demand for open cars fell off, and they became obsolete.

In 1916, 200 new cars were bought on an instalment basis, 25% being paid down, and $130,000 to be paid each year for 10 years on car trust certificates. One hundred and fifty decrepit old cars were assigned to salvage as an offset to this purchase. The management found, however, that the purchase of these large, heavy cars was a mistake, for at about that time the agitation for the economical light-weight cars was being started.

In order to maintain its credit and to continue paying dividends, the company omitted to charge off sufficient depreciation for several years. The poor financial condition of the company made it impractical to retire any more of the cars before 1917. In that year, however, a crisis was reached which put the company into the hands of a receiver who held it together until a reorganization was effected in 1919, at which time a petition was made to the state to increase fares. An appraisal showed the property to be worth $40,000,000 on a pre-war basis. Included in this figure were $8,000,000 for 2,700 cars, of which 1,500, represented by $3,000,000, had been out of use, needed rehabilitation, and could not be sold. Of the $40,000,000, 4% was in land, 44% in track and road, 21% in cars and equipment, 13% in power plant, and 6% in shops and car barns. From time to time parts had been taken

from idle cars to replace worn parts in those which were running, and the company found that a number of cars were practically shells.

In 1919 it was agreed by the company and the state that the company should be managed for a period of 10 years by a Board of Public Trustees, who should have the power to regulate fares and should endeavor to reestablish the company's credit, to maintain the property and bring it to a state of usefulness, and to earn, if possible, 6% on the appraised value of $40,000,000 for the investors. The classification of accounts of the Public Utilities Commission had, however, to be used by the trustees in their accounting. Immediately upon taking office, these trustees began to put the company on a solid financial basis.

During the years 1919 to 1922 when there was some market for car barns, 39 out of a total of 55 were sold, and 650 old cars were sold for the metal they would yield. Cars which had cost originally $3,500 to $4,500 brought $75 to $300 as junk. These cars stood on the books at a large figure, and since adequate depreciation and obsolescence had not been charged off and there was no reserve to take care of the loss sustained when they were disposed of as junk, a huge deficit was incurred. Large savings were made, however, in reducing the expense for car barns and maintenance, and in insurance, interest, and taxes. Some parts of the old cars were set aside for the maintenance of new ones.

The attention of the Public Trustees has been given principally to decreasing expenses and increasing efficiency. In the years 1919 to 1920, 250 new one-man cars were bought. They can be operated for $3,000 less per year than the average two-man car and they cost $6,000 each, so that the saving effected will pay for them in two or three years. When they were purchased, 175 of the old cars were retired. In the shop a task-and-bonus system of wage payments has been introduced. Time studies afford the basis for setting a standard time for each job, and each worker is given a bonus of one-half his hourly wages for all saved time. Thus, if eight hours is standard for a job, and wages are 50 cents an hour, a workman completing the job in six hours will receive six hours' pay at 50 cents an hour, or $3, and a bonus of 25 cents an hour for the difference between

the eight hours standard and the six hours actual time taken. The resultant saving is shown by the fact that it now requires one shopman to 4½ cars as against one man to 2½ cars in the old days. The average car now goes 5,000 miles without requiring mechanical attention. The average fare is now 7 cents; the income is about $11,000,000 yearly; and the passengers are being carried in less than 700 cars, only 584 being used every day.

Is the company justified in carrying the charge to extinguish the deficit caused by disposal of old cars as an operating expense of each year?

Should the company grant the request of the stockholders that part of the money now being put into new equipment to replace the old should be paid to them as dividends?

5. STONE VALLEY STEEL CORPORATION—DEPRECIATION OF STEEL PLANT

The Stone Valley Steel Corporation has recently placed six of its accounting force into a special subdivision of the auditing department to make an accurate list of all physical property owned by the company and its present valuation. On the basis of this complete list of capital equipment the management hopes to establish a more accurate system of depreciation which will show at all times the actual condition of its property, by means of a plant ledger which has been tentatively designed as shown in Form 33. The essential plan of the buildings and more important machinery used in producing steel has not changed greatly during the last few decades. Those parts of the plant which were built 50 years ago have been equipped with modern machinery and can be operated about as efficiently as those parts built within the last few years. Changes of machinery have occurred so often that the problem of accounting is rather one of obsolescence than actual depreciation. Where machinery has not been superseded by improved models, its life in most instances is long, and its efficiency can be sustained by adequate maintenance.

At present the company is figuring its depreciation on the basis of total ingot production. It has been a question with accountants in the past as to what allowance should be made for

depreciation of plant and equipment when the mills are run at full time throughout the whole year as compared with when the mills are operated on a reduced schedule. In other words, what allowance should be made for a change in rates of depreciation because of a change in the amount of time the plant is operated? By fixing a flat rate to be charged for depreciation for each ton of ingots produced, the company has obtained a figure which

PLANT LEDGER

Department Number _____ Classification Number _____

Item Number	Description	Acquired					Depreciation			How Disposed of			
		Date	Cost	Additions Date	Additions Cost	Total Cost	Rate	Amount	Net Value	Date	Book Value	Amount Received	Loss or Gain

Form 33: Plant Ledger

took into account this factor of variable production. The amount to be charged per ton has been determined on the basis of past years' experience in actual lessening of capital values.

When the molten steel comes from the furnaces, it is poured into large molds where it is left to cool and harden. The resulting blocks of steel are the ingots from which all further steel products are made. This method of using the production of ingots as a basis for depreciation charges apparently does not take into account to production of pig iron. Although the company sells some of the pig iron which it manufactures to foundries and other customers, it does not operate its blast furnaces to produce this pig iron except when it needs iron for the manufacture of steel in its own furnaces. Since the quantity of ingots produced, therefore, reflects the amount of iron made in the blast furnaces, it appears that the ingot is a unit on which the entire production of the company rests and is as satisfactory as any available single unit in determining depreciation.

The following quotation from the Official Publications of the National Association of Cost Accountants [1] deals with this matter.

[1] Volume IV, No. 13, p. 4.

Effect of High Production on Equipment and Depreciation

Production is one of the most important causes of depreciation. Machinery is purchased for the specific purpose of turning out production or aiding indirectly in doing so. In a great many cases engineers can roughly estimate the approximate number of units of production which a machine will manufacture before it is ready for the scrap heap. It is logical to assume, therefore, that hastening the processes of production will accelerate the rate of depreciation.

Normally, as far as production is concerned, depreciation is caused by actual contact of the product with the machinery, and, with respect to auxiliary equipment, by the number of motions or movements necessary to keep in operation the equipment engaged directly in production. In cases of high production we have more production units coming in contact with what we might call Primary Equipment and a noticeable increase in the number of movements of auxiliary equipment to keep pace with increased production. It is true, therefore, that the demands of high production will affect not only the equipment with which the steel in the various manufacturing processes comes in direct contact, but also auxiliary departments or equipment such as steam or electric generating departments, gas producers, coal pulverizing equipment, and so forth. This is patent. If high tonnage of steel is handled in the furnaces, there will be extraordinary usage of cranes, charging cars, gas producers, steam generating equipment, and so forth, to keep pace with the increased demands of the production department.

An excellent illustration of direct depreciation is found in the blooming mill where every ton of steel made in the open hearth furnaces in the form of ingots is reduced, by a rolling process, to "blooms." Glancing into a blooming mill one is struck by the maze of machinery. Every ton of steel that passes through the rolls jars the entire rolling mechanism, and contributes its quota of vibration which in time undermines even the foundations. It logically follows that an increase in the tonnage of steel passing through the blooming mill, will correspondingly increase the rate of depreciation in this department.

Taking into consideration the length of life of steel equipment, if there are no improvements to make it obsolete, and the great importance of obsolescence if such improvements are made, which is the more satisfactory system: first, that whereby the company charges a fixed rate for depreciation per ton of ingots produced, or second, the charge made on the basis of a complete list of equipment, depreciated at what is considered by the company's engineers to be a fair rate for each piece of equipment?

6. THE BOND PRESS—ACCOUNTING FOR DEPRECIATION

The Bond Press operated 25 cylinder and 4 job presses. Following the advice of the United Typothetae of America, the company had depreciated its machine equipment 10% a year. Since this rate was large enough to be conservative, the life of several of the presses extending over 15 or 20 years, the original cost value in some cases had been more than wiped out through the depreciation charges, although the machines were still useful. Inasmuch as the company was suffering severe competition and wished to ascertain the actual manufacturing costs for its product, it was suggested that a more accurate method of treating depreciation be used.

A machine ledger with a separate card for each machine was recommended. These cards would be designed to furnish a complete history of each machine, including the original cost price, yearly charges for taxes, interest, insurance, and depreciation, rated and actual horse-power, name of the maker, and any other information that might be valuable. When a machine had been depreciated to its approximate scrap value, no further depreciation would be charged to it. Objection was made to this method because it was impossible to foretell when some of the presses, perhaps relatively new, would have to be dispensed with because of obsolescence. If the new method were adopted, and a reserve set up to take care of this obsolescence, the costs would be no more accurate than under the old method, and the expense of keeping the machine ledger would be incurred to obtain records of no practical value. The old method had been in operation during the company's long and successful life.

Should the Bond Press have changed its method of booking depreciation?

7. THE HALE PRESS—ACCOUNTING FOR DEPRECIATION ON UNUSED MACHINES

To meet the business expansion during the World War the Hale Press used day and night shifts for 14 months in its pressroom, in which it had 25 cylinder presses. From 18 to 20 of these presses were operated 48 to 60 hours per week at night during the greater part of this time. Because of the female labor employed in the bindery, night work there was impossible,

and 20 additional sewing machines were bought at a cost of $1,250 each. In the depression that followed the war there was only occasional work for the new machines. In figuring depreciation in the cost of jobs, however, 10%, the rate advocated by the United Typothetae of America, was taken on the new machines as well as on the old.

Inasmuch as the company's business was growing steadily, all the machines undoubtedly would be used in the future, so it was deemed unwise to dispose of them. The costs of carrying vacant land owned by the company were treated as "other expenses" on the books, and it was suggested that the carrying charges of the new sewing machines, including depreciation, be booked in the same way. The new machines, however, were used occasionally when the bindery happened to be exceptionally busy, or whenever they were more convenient. In 1922 it was felt that the company needed at least three or four of these new machines.

How should the Hale Press have accounted for depreciation on the new machines?

8. LAFLAMME PRODUCTION COMPANY—DEPRECIATION AND USE, COSTS OF SETS, PROPERTIES, AND WARDROBE

For nine years the LaFlamme Production Company did not produce any motion picture films, but distributed pictures which it purchased from other companies before their release. By a careful selection of productions the company built up an excellent reputation for its releases. It decided, therefore, that it could capitalize this reputation by producing its own pictures.

A cost plan was adopted which attached costs directly to each production, but its treatment of sets, properties, and wardrobes was considered superficial. The officials of the LaFlamme Production Company believed that the Kirkpatrick Picture Corporation and the Preston Picture Corporation had developed their cost systems more highly than most companies in the industry. Consequently, it was decided to incorporate in the system for the LaFlamme Production Company the best methods used by these companies for the depreciation of sets, properties, and wardrobes.

If a set for which no future use could be foreseen were con-

structed for the Kirkpatrick Picture Corporation, the entire cost was charged to the production for which it was made and the set was "struck." However, a "still" picture was taken of the set. Each part and article was given a number and on the back of the picture a key was made which identified each piece and gave its cost. This picture was filed and used in estimating costs of sets. In the event that it was believed probable that a set might fill some future requirements, it was labeled a stock set and a fair salvage value placed upon it. No charge was made for its subsequent use. It was reappraised each year, however, and the decline in value was charged to general overhead. Adjustment of the book figure was made at each appraisal period, and the appraisal figure was carried as an asset item throughout the year. In practically every case the doors, windows, stairways, and special cast metal work of each set were retained, even though the set were "struck." The Preston Picture Corporation charged off the total cost of a set to the picture for which it was made, even though the set were retained for future use. Officials of this company asserted that as no satisfactory method had been devised whereby subsequent productions could be charged a rental for the sets, it was unwise to carry them as an asset, since their actual value was contingent upon subsequent usage which could not be forecast.

The property account of the Kirkpatrick Picture Corporation was treated in a different way from the set account. The property account represented various equipment used in productions, such as furniture, bric-a-brac and ornaments. Each piece of equipment was stored in a property room and assigned a number. A separate record of the cost of each was maintained. The company rented such equipment from outside agencies whenever possible, particularly when it appeared that the equipment would be required only for one production. If it were necessary to buy properties which could not be used again, the difference between the salvage value and the original cost was charged to the production in which it was used. If a "prop" were used in a number of productions, a rental charge was made to each and the "Prop Fund" was credited. This fund account was cumulative and was closed out annually. When equipment was issued from the stockroom, a record was kept of the delivery and checks made to insure its return in good condition.

If an article were lost or damaged, adjustment was made on the books, and the production in which it was lost or damaged was charged with its value. Inventories of equipment which were based entirely on the judgment of the property storekeeper were taken annually. The practice followed by the Preston Picture Corporation was to create a separate property department and charge it with all costs of equipment. A flat depreciation of 25% a year was made on all properties, and each picture which used owned properties was charged a rental of 10% of original cost.

Treatment of the wardrobe account of the Kirkpatrick Picture Corporation had not been uniform. Originally the production for which the costume had been designed or purchased was charged with the difference between the cost and the salvage value which could be realized immediately, either from the sale or the use of material in other costumes. This method had been discarded for another whereby those costumes which were placed in wardrobe stores were given an appraised value after the first usage. This generally was 25% of the original cost. Rental rates then were fixed, so that if a costume were used in three future productions the cost would be entirely absorbed. This had been deemed unsatisfactory, since it required separate records for each costume and there was no method of gaging the number of times a costume might be used. If it were used once and carried for two or three years, the unabsorbed portion of its cost was thrown into overhead. If it were used more than three times, no charge was made to productions after the third. The last method adopted by the company was to charge 75% of the cost of the costume to the production for which it was made or purchased. The remaining 25% was carried as an asset and depreciated monthly for 30 months. No charge was made to the pictures which used the costume after the first production. The Preston Picture Corporation used the same method on costumes as on properties. The wardrobe account was debited with all costumes, and credited annually with a depreciation of 25%. Each production was charged a rental of 10% of the cost price.

Which methods should be adopted by the LaFlamme Production Company for depreciating sets, properties, and wardrobes?

9. WYANTENUCK COAL COMPANY—CHARGES FOR DEPLETION ON COAL FIELDS

The Wyantenuck Coal Company operated two mines in the bituminous coal district of West Virginia. These mines were located in two separate fields in the same district. The company owned 500 acres and rented 1,000 acres from a holding company, for which it paid a charge of 10 cents for each ton of coal taken from the mine, with a minimum charge of $25,000 a year. Normal daily production from this rented land was 1,500 tons a day, or about 450,000 tons annually. In the preceding ten years there had been two years when the company had not mined sufficient coal from this field to pay for the minimum royalty on the basis of 10 cents a ton. The land owned by the company had been bought two years previously at a cost of $200 an acre. Normal production for this mine was 1,000 tons daily, or about 300,000 tons a year. The company's engineers estimated the probable length of life of this mine at 25 years at the above-mentioned rate of production.

In determining the cost of the coal mined from these two fields, the company charged the rental figure of 10 cents a ton on all coal taken from the leased land in spite of the fact that, in the two years mentioned above, the actual charge had been more than 10 cents a ton, because of the failure to remove 250,000 tons during the year—the amount necessary to make up the minimum royalty. In determining costs in the mine operated on the land owned by the Wyantenuck Company, no charge had been made for depletion. The omission of this charge had been made for two reasons: first, the company had been in the habit of purchasing new coal lands from the net profits so that depletion of the old field was compensated for by the addition of new acreage; the price of coal, because of the possibilities for overproduction throughout the country, is determined solely by competition in the various districts. Consequently the company had not deemed it advisable to add to the difficulties of its accounting by figuring a charge per ton for depletion.

It was suggested that a charge for depletion should be made on the coal taken from the land owned by the company in order to provide comparable costs between the two mines as a gage

for efficiency of production. One of the difficulties in estimating a proper depletion charge is that, although the engineers may make an estimate as to the total amount of coal under ground, it is impossible to determine accurately just what difficulties may be encountered in mining. There is always the danger of running into rock structure that will make it impossible to get out a large proportion of the coal. There is also a possibility that in opening up the lower levels, they may be flooded and further mining rendered impossible. In addition, the risk of cave-ins which will make necessary the sinking of a new shaft is always present.

Two methods of figuring this depletion were suggested to the Wyantenuck Company. The first was to charge the same rate of 10 cents a ton that was paid for rent on the leased lands. This would make costs in the two mines comparable but had the disadvantage of being a larger charge than was considered necessary by the engineers of the company even when all the various risks were taken into consideration. The second method was to charge a rate of 7 cents a ton which was that recommended by the engineers as being sufficient to cover the actual value of the coal in the ground, and in addition covered what they considered to be a sufficient amount of insurance against the difficulties mentioned above.

Should the Wyantenuck Coal Company have made a charge for depletion on coal taken from its own land? If so, which rate should have been used?

10. SANDY RIVER TIMBER COMPANY— COMPUTATION OF DEPLETION

In order to make its tax returns the Sandy River Timber Company must figure its income on 20,000 acres of timber property which was bought in 1914 for $210,000. The value of the land itself was 50 cents per acre. Since unit-depletion value is the amount of money per unit of timber deductible from capital as an allowance covering the decrease in capital value through cutting, the capital recoverable through depletion is $200,000. An estimate in 1914 showed 100,000 cords of merchantable timber of which 75,000 cords were pulpwood, and 25,000 cords

pine and spruce sawlogs. At the time of purchase the hardwoods on the property were deemed valueless. No improvements or expenditures were made on the property except about $71,000 for taxes, and $28,500 for carrying charges, not including any charge for interest.[1]

No cutting was done on the land until 1922, when the right to the following amounts of timber was sold to an operating company.

50,000 cords of hardwoods at $2.25 a cord
75,000 cords of pulpwood at $5.00 a cord
25,000 cords of sawlogs at $4.00 a cord

A cruise preceding the cutting of the wood showed the following quantity of merchantable timber:

125,000 cords of pulpwood
35,000 cords of sawlogs
100,000 cords of hardwood

What was the income of the Sandy River Timber Company from its 20,000-acre tract in 1922?

B. SPOILAGE AND WASTE

11. THE KING TEXTILE MILLS—WASTE

ALTHOUGH in the King Textile Mills,[2] allowance is made for cotton waste in the cost of the finished product, no account is taken of the loss in labor and overhead applied to this waste.

Waste occurs in all but two of the operating departments of the mills, as shown by the percentage of waste or regain in the table on page 273.

In the picking and carding department, the waste is composed of the hoops and sacking removed from the bales and the foreign matter and short-length fibres removed by the picking and carding machines. In the spinning department the waste

[1] Many timber companies have bond issues on their timber-lands, in which case bond interest paid is a necessary charge. Frequently compound interest is added to the original cost of standing timber, whether it is actually paid on bond issues or not. In eight years at 6%, $1 will amount to $1.593848.

[2] The King Textile Mills, equipped with 5,000 looms and 200,000 spindles, produces standard grade goods which are sold through commission agents.

is chiefly broken yarns although some lint is accumulated in the machines. The waste from the spooling department and from the warping department consists also of broken ends of yarn. In the dressing and drawing-in department there is some waste of broken ends, but there is a regain in the weight of the sizing materials which remain in the warp yarns. The weaving waste is caused by imperfections in the weave which must

Operating Departments *	Loss
1. Picking and Carding	16%
2. Spinning	4%
3. Spooling and Warping	.5%
4. Dressing and Drawing-In (Warp only)	10% Regain
5. Weaving	2%
6. Cloth Room	0

* In the picking and carding department, the cotton bales are opened, the fibres broken apart in the picking machine, and the cotton cleaned. Fibres are then laid in approximately parallel position and further cleaned in the carding machines. From the carding machines the cotton in laps is drawn out into ropes on slubbing frames, into thinner ropes on intermediate frames, and into a heavy cord or roving on the speeders. In the spinning department, the rovings from the speeder frames are combined with other rovings, drawn out, and twisted into yarn. In the spooling department several bobbins of yarn received from the spinning department are wound in a continuous length on large spools; then these spools are unwound and rolled on a warping beam in the warping department. Each beam contains the number of warp yarns required for one-quarter to one-sixth the width of cloth into which it is to be woven. Four to six of these beams are combined in the dressing and drawing-in department into a single slasher beam, after being passed through sizing material to give the yarn strength sufficient for the weaving process. In the weaving department the filling yarn, which is received from the spinning department on bobbins, is woven into the warp on the looms. The finished cloth is sent from the weaving department to the cloth room where it is inspected, baled, and shipped.

be cut out, and by oil which drops on to the cloth. A large percentage of this spoiled cloth is sold as seconds at a slightly reduced price.

In addition to these visible wastes there are invisible wastes due to the moisture content of the cotton, because the weight of cotton may vary 8% with the amount of moisture content. There is also a waste in the minute fibres which float away in the air.

From the standpoint of operating, the waste problem is one of watching the grade of cotton which is put into process and of keeping the machines operating efficiently. The waste from each set of machines is kept separate and carried in containers to a waste room where its weight is entered on a waste sheet according to source. Operatives and workroom supervisors can detect excessive waste quickly, and adjust machines to eliminate

it. The total waste per week is kept by departments and types of machines, but is not used either for controlling waste or in accounting for waste.

In pricing a style of cloth the standard weight per yard is multiplied by a standard percentage which makes an allowance for the cotton waste in process. Thus with cloth weighing five yards to a pound, the amount of cotton going into that cloth is one pound divided by 80% (20% waste) which at the cost per pound of cotton gives the amount added to manufacturing costs for the raw material. The waste percentage is arrived at by finding the difference in pounds of cotton opened up during a representative year and the pounds of cloth produced during that period. The balance, adjusted for sales of waste, is considered the gross waste of the mill.

Since, however, the manufacturing costs are built up on a pound basis in the various departments without the allowance being made for waste, the costs are not accurate. The present method of costing a representative style of cloth composed of Number 30 filling and Number 28 warp [1] is as shown in the tables on pages 275 and 276.

The management has found that in a nearby knitting mill, waste is accounted for in a different manner. Each department is charged with its raw material at a cost including material and labor of the department preceding, and in turn charges the next department for the raw material which it delivers at a cost which includes both raw material and accumulated labor. A monthly statement is made, and a physical inventory taken by valuing the goods in process in each department at a material cost plus a standard percentage for the amount of labor. The inventory is thus always conservatively valued. Each department shows a profit or loss on standard so far as prime costs are concerned. The final department is credited with the material at a figure which is accepted as the cost of sales.

This cost of sales should check with the cost shown by the manufacturing account, which arrives at a profit and loss independently by accumulating as debits all labor material and

[1] These numbers are the "count" of the yarn used for filling and warp. The count of cotton yarn is based on the number of hanks of 840 yards to a pound. A 28's yarn is 28 hanks to a pound.

FILLING—30's

	Picking and Carding	Spinning
Direct-labor cost per pound *	1.552 cents	2.36 cents
Cost after adding percentage for indirect labor †	(80.01%) 2.795 cents	(35.88%) 3.21 cents
	(84.88%)	(95.75%)
Cost after adding percentage for burden †	5.167 cents	6.28 cents

WARP—28's

	Picking and Carding	Spinning	Spooling	Warping
Direct-labor cost per pound *	1.257 cents	1.72 cents	.8841 cents	.176 cents
Cost after adding percentage for indirect labor †	(80.01%) 2.273 cents	(40.94%) 2.42 cents	(24.92%) 1.10 cents	(108.91%) .37 cents
Cost after adding percentage for burden †	(84.88%) 4.202 cents	(95.75%) 4.74 cents	(36.47%) 1.50 cents	(36.47%) .50 cents

DRESSING AND DRAWING-IN (WARP)

Total payroll $700.60 ÷ pounds warped 88,655	=	.79 cents per pound
With overhead (64.51%) †	=	1.30 cents per pound
Starch and sizing $765.04 ÷ 88,655	=	.86 cents per pound
		$2.16 cents per pound

Weaving		Cloth Room	
Direct-labor * per pound	2.00 cents		Cents per yard
Cost per pound † with percentage for indirect labor	(68.69%) 3.374 cents	Total payroll 641.55 = (Yards product 626.345)	.102
Cost per pound with percentage for overhead †	(69.12%) 5.71 cents	Overhead (51.16%) =	.052
		Packing materials $221.82 =	.035
			.189

* Piece-rate except in spinning department where operatives are paid on a day basis for each side of a spinning frame tended. The cost per pound there is determined for 100% production by figuring the size of the yarn (yards to pound), the r. p. m. of the front roller through which the yarn passes before being wound on bobbins, and the day-rate of the operative tending the machine.

† Percentages are figured for a normal period.

COST CARD

Cloth Style X	Weight, 5.00 Yards per Pound	Width, 32 Inches
Yarns		Cost, Cents per Pound
Warp 28	55.5% x 10.94 cents	Pound Cost = 6.07
Filling 30	44.5% x 11.45 cents	of Yarns = 5.10
		11.17
Dressing and Drawing-In	Warp 55.5% x 2.16 Cents per Pound	= 1.20
Weaving		= 5.71
Cloth Room and Packing	.179 Cents x 5.00	= .95
Total Manufacturing Cost		19.03
Selling Expense	3% of 50 Cents per Pound (Estimated Selling Price)	= 1.50
Cotton	22 cents ÷ 82% (Waste Allowance)	= 26.83
Cost per Pound		47.36

burden costs during the period and the sales as credits. In this account the inventories of each operating department are valued at a standard rate for both labor and overhead added to the actual cost per pound of the raw material. Waste is accounted for by including the total accumulated charges of labor and raw material in the cost of the product turned over by one department to another.

Since this system makes no distribution of burden to departments, it is impossible to secure an accurate value of inventories of goods in process or an accurate allocation of burden to the mill's different types of product. It has the advantage, however, that the simplicity of bookkeeping permits the compilation of monthly statements which indicate the actual costs incurred in the plant and the profit made. It is argued that the application of burden as a percentage of labor costs accumulated on each style of product gives an accurate valuation for inventory and costing purposes, and that at the same time it makes unnecessary the distribution of burden to the operating departments. The fact that inventory taking requires one afternoon per month of the overseers and their assistants is considered a minor objection by the knitting mill. There is, however, some

difficulty in making these inventories accurate because goods in process must be estimated; variations from this cause may affect the profit of a short period considerably.[1]

Under its present system, the King Textile Mills minimizes the effect of such variations by taking inventories quarterly instead of monthly. It also distributes burden to operating departments so that the differences in overhead absorbed by the several counts of yarn and styles of cloth are reflected in their costs. It has been pointed out that by using the waste percentages in the different operating departments, and by working back from the weave room it is possible to express direct-labor costs in pounds of finished product rather than in pounds actually worked. Then if indirect labor and overhead are applied to this cost, allowance would automatically be made for loss in waste of overhead and labor in the manufacturing cost of the finished product.

What method should the King Textile Mills use in accounting for overhead and labor in waste?

For what reasons is it desirable to get accurate measures of waste?

Is it necessary to do so on a departmental basis? Why?

Revise the Cost Card in this problem to show the effect of changes you suggest.

12. THE OFFICE DEVICE COMPANY—ACCOUNTING FOR SPOILAGE

The Office Device Company, which manufactured over 2,000 cards and forms for office records, always took advantage of the 10% leeway allowed stationery manufacturers. For example, if a retailer ordered 1,000 cards of a given form, the manufacturer might deliver any number between 900 and 1,100 at his option. The Office Device Company, therefore, laid out material for 1,100 cards whenever it received an order for 1,000. For a recent order of 1,000 cards, 957 perfect cards were produced, but as 143 cards were spoiled, the cost sheet for the order was charged with raw material for 1,100. Since the order was a special one on which the salesman had not set a price,

[1] Goods in process may be yarn or rovings on thousands of bobbins, each of which has a slightly different quantity of material on it; it may be different lengths of picker laps, which are sheets of cotton wound on steel beams or cores; or it may be partially used warp beams which contain the yarn not yet woven into cloth. The weight of these must be estimated.

the Office Device Company, in accordance with its regular policy, billed the order to the customer at the manufacturing price plus 50%. Because of the large percentage of spoilage, the cost was so high that a complaint was received from the customer. The company, therefore, was considering charging spoilage as general overhead rather than as a direct charge.

The present method of distributing spoilage charges was introduced because most of the spoilage was incurred on special orders which, it was believed, should bear their actual costs. Most of the regular lines, moreover, were subject to severe competition, and the company had been striving to keep costs on them as low as possible so that the volume of sales would show a progressive increase. Since most of the special orders, however, were received from customers who generally bought the company's stock lines, it was necessary to accept the larger part of them.

Should the Office Device Company have charged spoilage as part of the general overhead or as a direct cost?

13. STEVENS PAINT COMPANY—ACCOUNTING FOR SPOILAGE

The superintendent of the factory of the Stevens Paint Company states that although batches were sometimes spoiled in process, there was no loss from spoilage in his factory. To illustrate his point, he says that on one occasion an employee used zinc oxide, an active pigment, with varnish, instead of lithopone. The reaction between wood, oil, varnish, and zinc oxide gave a paint of a mushy consistency instead of the standard body. When the foreman of the mixing department discovered the mistake, the batch was immediately stopped. It was held in the tank, however, and mixed in eight subsequent batches until it was used. The superintendent maintains that, although the equipment was tied up, it was not expensive, because the factory was not running at capacity.

Frequently batches are spoiled for some minor reason, but the spoilage is not detected until the paint has been sent to the testing department. In such cases the paint is held in a tank from which paint is packed, and is gradually fed into subsequent batches. Because these tanks are inexpensive, the fact that one is tied up until the paint can be put into process again has not been considered an item of cost worth accounting for.

The processes of manufacturing paint may be classified into mixing, heavy grinding, fine grinding, tinting and thinning, and filling the containers. The cost accounting system in use by the Stevens Company is not detailed. When a new formula is produced, the cost of manufacturing the paint is estimated on the basis of the time required to mix the pigments and oil, grind the paste, and thin the product in the case of house paints. Packing costs vary with the size of the containers. The labor cost in each department is added to the overhead in order to obtain the total cost of operating each department. After a test order for a formula is run through the factory, 10% is added for general overhead. This cost per gallon becomes the standard manufacturing expense of that paint until it is deemed necessary to put through another test order.

Would it be advisable for the Stevens Paint Company to account for its spoilage? If so, how should this accounting be handled?

14. THE BELL LOCK COMPANY—ALLOCATING OF SPOILAGE CHARGES

The Bell Lock Company manufactured all kinds of locks and numerous other articles from brass. Much of the workmanship required skilled labor; and spoilage of material, therefore, especially in the more advanced stages of production, was a source of substantial loss, because of the value of the raw material and the cost of the labor. For this reason the Bell Company always had made it a point to obtain careful reports, similar to that shown in Form 34, on all spoiled material, and to attach definite responsibility for the spoilage.

Spoilage was due chiefly to three causes—defective material, poor workmanship, and defective tools or dies. Defective material could not always be recognized in its crude form, and imperfections often did not appear until some of the finishing processes were commenced. Spoilage due to material was charged to the mill department, since the company manufactured its own brass sheets and rods. Poor workmanship, of course, was charged to the department in which the workman was employed. Defective tools and dies likewise were charged to the department in which the tool or die was used, but objection

was raised to this method on the ground that the tool- or die-making department should be responsible for this type of spoilage. The foreman of the die department maintained that the foreman of a productive department should be responsible for tools and dies, inasmuch as they often were damaged or became defective through wear after they were beyond the control of the die-making department.

It had been called to the attention of the comptroller that spoilage was credited to work in process and charged to the responsible department at a rate which included only material

Standing Order Number	Production Order Number	Register Number	Department Number	Date
Report on this form all articles spoiled in process of manufacture, both labor and material, giving full particulars including quantity, weight, labor, cause of defect where possible, production order number, and register number; this applies to all cases where loss exceeds $1.				
To Mr.			Superintendent of Manufacturing Departments	
Material	D. Supplies	F. Supplies	Labor	Total
Noted		Superintendent		Foreman

Form 34: Report Form for Spoiled Material

less salvage value and direct labor; overhead, which would have applied to these articles, therefore, was left to be absorbed by the finished articles in the order. Overhead varied in different departments from 75% to 175% of direct labor.

Spoilage charged to a department was included in a separate account. A normal amount of spoilage was allowed in the burden of each department; any excessive spoilage charged to the department, therefore, was evident at the end of the month by a debit balance in the spoilage account. It was the desire of the management that this balance should provide an index of the performance of the department. To obtain an accurate cost of spoiled work, and to give true weight to the seriousness of this item in a department's account, therefore, it was proposed

that overhead should be included in the charge against the responsible department.

Supporters of the method already in use asserted that the suggested plan would result merely in a juggling of figures and increase bookkeeping costs, and that all loss from spoiled work eventually had to be borne by the good production.

Should the overhead incurred by material which was subsequently spoiled have been charged to the department responsible for the spoilage, or should it have been absorbed by a supplementary charge to good material passing through the various departments?

C. DEVELOPMENT COSTS

15. ASHCRAFT STOVE COMPANY—DISTRIBUTION OF DESIGN COSTS

THE Ashcraft Stove Company figured its costs from estimates based on past experience, following the old rule of doubling direct labor and material costs in order to obtain the selling price. This had been considered sufficient to include manufacturing overhead, selling and designing expenses, and to yield a profit. A change of opinion of some of the owners of the company led to a revision of the cost system, and the cost system recommended by the National Association of Stove Manufacturers had been installed. This system collected direct costs by departments [1] and added a percentage overhead for each department based on past experience. The cost manual of this association stated that new pattern costs should be debited to a Pattern, Flask, and Follow Board account. This account should be depreciated annually and a corresponding debit made to Foundry Expense. The Ashcraft Stove Company, however, did not adopt this method of handling new design and pattern costs.

In 1923, after the uniform system had been in effect in this company's plant two years, the officials became dissatisfied with the old method of charging off design and pattern costs. In the

[1] In the stove business the trade custom has arisen to call only four departments direct departments. These are core making, molding, mounting, and fitting. Some factories also consider packing and blacking as direct. The other departments, such as cleaning, pattern making and designing, are considered as indirect.

pattern department nine men were employed; they did nothing but execute the plans of new designs which were drawn up by the president of the company. The annual expenditures of this department varied from $20,000 to $30,000 a year according to the number of new stoves added to the line. This did not include any of the salary of the president, which was $15,000, although he spent much of his time in drawing the plans. Each year two or three new stoves were made. The pattern department made wooden patterns from the drawings submitted by the president and sent them to the foundry. In the foundry, castings were made from the patterns; and these castings, finished and fitted, became the patterns kept for permanent usage. The company had always charged off as expense the total cost of the pattern department each year, without applying any of this cost directly to the stoves. It was the opinion of one member of the firm that some patterns were made up, and a new stove added to the line, the manufacture of which would have been undesirable to continue from a profit standpoint, if its cost had included pattern and design charges. The length of life of a pattern was entirely dependent upon the stove's popularity. Most patterns, however, were used for about 15 years before the style became obsolete; a few were continued as long as 30 years.

What method should have been employed by the Ashcraft Stove Company in attaching the pattern costs to the finished product?

16. BELLINGHAM RUBBER COMPANY—DISTRIBUTION OF COSTS IN THE LABORATORY

Today the work of the laboratory maintained by the Bellingham Rubber Company[1] has broadened into a variety of different lines, although originally it was maintained solely for the purpose of conducting experiments in vulcanization. When recording thermometers and pressure gages came into use, they were installed under the direction of the laboratory staff. As other delicate instruments were installed, their maintenance and operation fell to this department. Thus the scope of its work has

[1] The company is engaged in the manufacture of rubber footwear, including arctics, gaiters, boots, tennis, and all kinds of canvas shoes, as well as fabric, cord, and solid automobile tires.

gradually increased. When the activities of the laboratory were confined to one or two tasks, it was comparatively easy to distribute its costs. Now, however, the cost department is faced with the problem of how these costs should be distributed when the laboratory performs the following functions:

1. Installation, care and repair of recording thermometers, recording pressure gages, temperature or pressure controllers, and similar instruments.
2. Inspection and testing of all new instruments.
3. Daily checking of every batch of rubber mixed each day. The storekeeper, mixing departments, and cost department, must be advised of changes in the composition of the factory stocks, which take place almost constantly.
4. Maintenance of compounding cars.
5. Determination of the value of gum stock in the factory. All of the mixed stock in the calender room, cutting room, milling department, and elsewhere, is weighed once a month. The total number of pounds of each of the different stocks throughout the factory is reported to the laboratory, where the value is figured for the bookkeeping department. This value is reported not only in terms of the cost per pound, but also the value represented in each stock, the value of reclaimed rubber, and the value of the compounding ingredients.
6. The making of specifications for the purchasing department. Determination of what makes up all rubber mixtures, and the testing and experimenting with these mixtures.
7. Examination and testing of all inward shipments of material.
8. Physical laboratory tests the breaking strength, the stretch, and the permanent set of rubber and fabric. The twist of the thread, and the count in each direction of each fabric, is measured and recorded for each test.
9. Development, improvement and safeguarding of the stocks to be used in the making of the footwear.
10. Responsibility for the quality of all stocks studied closely through the "making" operations.
11. Comparison with competitors' goods in an effort to improve the quality.
12. Testing tires. The tires on the trucks and pleasure cars operated by the company are charged to the laboratory. They are put on the factory cars and worn out, the garage charged according to the number of miles each tire is run, and the laboratory credited for that amount.

The cost of operating the laboratory may be divided as follows:

Supplies. Gasoline, alcohol, office supplies, flasks, tubes, chemical instruments, acids, and chemicals.

Experimental Merchandise. Any product that is to be cut up.
Freight and Express. All incoming merchandise.
Maintenance of Laboratory.
Labor:
(50 employees)
Direct labor and Laboratory
Labor and supervision
Clerical labor

17. JOHNSON TALBOT ELECTRIC COMPANY—ACCOUNTING FOR DEVELOPMENT COSTS

The Johnson Talbot Electric Company manufactures 18 groups of signal apparatus and 35 different types of small motors in several sizes. During the last 40 years the business has grown steadily, and the lines of output have been increased to meet changing conditions. In 1916, the company appropriated $1,500 for developmental costs to be incurred in producing a new motor, many of the parts of which were common to motors already produced by the company. An additional appropriation of $528 was necessary before the motor was ready for the market. It was estimated at that time that 1,000 of these motors might be sold during the 5 following years, and it was, therefore, decided to charge off $2 of these developmental costs along with the other costs of manufacture of each motor.

The estimates of the company were seriously interfered with by the war, during which the company was forced to suspend a good deal of its regular business in order to fill Government contracts. The actual sales for this motor were as follows:

1917	96
1918	117
1919	27
1920	51
1921	75
Total	366

Since $2 has been charged off with each motor, $732 of the total outlay of $2,028, has been charged off, and $1,296 now remains in the developmental cost account. On account of the popularity of the radio, the management is planning to manufacture radio head-sets, and it has been decided to discontinue

the motor for which these developmental costs were incurred. The cost accountant, therefore, must make some disposition of the $1,296 which remained unabsorbed.

Since none of these motors have been sold in 1922, one alternative is to charge off the $1,296 immediately to surplus. It is urged, however, that some of the motors may be made up and sold at a future time, so that there is some reason for continuing a part of the developmental costs on the books as an asset. Again, it is maintained that since the manufacture of motors of this type is being discontinued in part on account of the production of radio head-sets, the radio department should be made to stand the losses incurred through its establishment. The suggestion is made, therefore, that the $1,296 be charged to the radio department, and pro-rated as an expense of this department over a period of several years.

By which method should the $1,296 charge be treated? What provision, if any, should be made for similar cases in the future?

18. THE LEFREER MACHINE WORKS—COST OF DEVELOPING A NEW MODEL

The LeFreer Company manufactures a variety of electrical machines to be used in manufacturing plants. Progress and change are always taking place in the models which they handle, so that, in order to hold the market, they are under the necessity of frequently re-designing old types, or of bringing out entirely new machines. The development of the model includes all the costs of designing and engineering, of making the detailed drawings, of small tools and patterns used in making the model, and of the expert hand labor involved.

When the model has been adopted and quantity production is ordered from the plant, it becomes necessary for the several shops to acquire such small tools and patterns as will enable them to handle the new model.

The company has one account for manufacturing overhead, and another account for "commercial overhead."[1] When it is added to manufacturing cost, the total commercial cost is ob-

[1] The latter includes selling and administrative expenses, and even some of the indirect manufacturing expenses, which it is thought can be distributed more accurately in this manner. The commercial overhead is distributed on a product basis.

tained. It is contended by some that the cost of development should be charged to the commercial overhead on the ground that it is a cost of retaining the market. Other members of the staff wish to include it in the manufacturing overhead; and still others recommend that the expenses be set up as an asset to be charged off to the machines of that model which shall be subsequently produced. The last named group says the cost of new models is akin to obsolescence, in that it is intended to prevent obsolescence in the product.

It is generally recognized that the costs of equipping shops with new tools and patterns for quantity production of the new model should be treated differently from the expense of developing it. It is believed that if these expenses of providing new tools for quantity production are charged to the factory overhead, the factory executives will be more economical in their orders for this new equipment. On the other hand, it is desired to afford as much incentive as possible to the factory workers to devise new methods of cheapening the output.

Another consideration is the necessity for having the asset accounts reflect the total value of equipment on hand, with a subsidiary inventory to supply the details, for the purpose of providing adequate insurance data.

What disposition of these two classes of expense do you advise?

D. INTEREST AS A COST

19. JACKSON ELECTRIC COMPANY—INTEREST AS A COST

THE Jackson Electric Company manufactures two principal classes of output—motors and signal apparatus. Since the company's line of motors consists of 35 different groups, and each group contains motors of various sizes, it was necessary for the company to install testing apparatus which cost $75,000. In the signal department, however, the devices used for testing were purchased at a total cost of $3,000.

On account of the large difference in the investment in testing apparatus of each of these two divisions, the management was disposed to believe that it could secure comparable costs only by including interest on the investment in equipment as a manu-

facturing cost. It was loath to take this step, however, because it had learned at an association meeting that interest was not being included as a cost by some of its competitors, and it was feared that the company could not compete effectively if it was not on the same cost basis. On the other hand, it had the following statement of the Harvard Bureau of Business Research [1] as to why it included interest as a cost of doing business, in its retail trade investigations:

> In its investigations of the costs of doing business in retail and wholesale trades, the Harvard Bureau of Business Research considers as an operating expense interest on owned capital as well as interest on borrowed capital. The effects of this treatment of interest are that total expense is increased and a more exact definition is given to net profit. The final earnings of the business, however, are unaffected, since the interest charge for owned capital is credited back to the business through an item called "Interest and Rentals Earned" before the total net gain for the year is determined. It is necessary that interest on capital owned and interest on capital borrowed both be handled in the same way if comparable figures are to be collected from a large number of businesses. If one merchant is operating entirely on his own capital and another borrows half the capital employed in his business, for example, relative interest charges on the two businesses obviously can be compared only by determining the total interest charge for each business. While this method of treatment will readily be conceded as necessary to the securing of fully comparable expense figures, there are other aspects of the interest question which concern many business men. There is practically complete agreement that from every point of view interest on borrowed capital should be treated as an expense, but there has been some controversy in regard to the proper method of accounting for interest on owned capital.
>
> In its original system of operating accounts, that for shoe retailers, the Bureau undertook to treat interest, both on borrowed money and on the net investment, as an application of net profit. The form of statement (condensed) was as shown on the next page.
>
> Some of the objections to treating interest as an application of net profit were recognized when the Harvard System of Accounts for Shoe Retailers was drafted, but, for reasons of expediency, that treatment was adopted. In five years' experience, however, the Bureau encountered difficulties which were not fully anticipated at the outset. These difficulties arose largely because of the provision in the retail accounting system that interest on capital owned be charged at the current rate for unincorporated businesses, but that corporations enter their dividend payments in lieu of interest on capital owned. This

[1] Bulletin No. 29—*Explanation of Schedule for Department Stores*, pp. 24-32, Bureau of Business Research, Harvard University.

Gross Profit on Merchandise		.....
Total of Expense Statement (includes proprietor's salary and rent of owned store, but does not include interest)		.....
Net Profit (or Loss) from Merchandise Operations		.....
Total Other Net Profits (or Losses)		.....
Total Operating Net Profit (or Loss) of the Period		.....
Application of Total Operating Net Profit		
Interest on Capital—Borrowed	.....	
Interest on Capital—Owned	.....	
Dividends on Capital Stock	.....	
Total Interest and Dividends		.....
Final Surplus (or Deficit) for the Period		.....

made the returns unsatisfactory. A corporation may pay dividends which are in excess of the amount that would be charged upon the capital actually invested if the charge were made in the form of interest rather than as dividends; or a private concern may incorporate and reduce its total interest and dividends even if the investment continues the same. This will happen if the dividends paid are less than a fair rate of interest on the actual investment. Figures for such a corporation cannot be compared fairly with the figures of an unincorporated business of the same size.

In the second place, although the final surplus shown on the profit and loss statement for incorporated companies agrees with the balance sheet surplus, the final surplus for unincorporated businesses is not necessarily a balance sheet surplus, since all or a part of the interest charged on capital owned may be left in the business and this fact not shown on the Profit and Loss Statement. These practical difficulties in the utilization of the retail accounting systems were experienced by the Bureau in summarizing the figures which it collected from shoe retailers and retail grocers for the first few years.

In deciding to reconsider the method of treating interest, the Bureau was influenced not only by these practical difficulties but also by numerous business men who strongly urged the inclusion of interest as an expense. After reopening the question, it was discussed not only with reference to the shoe business but with reference to other mercantile and manufacturing businesses. The Bureau obtained the advice and opinions of many business men, manufacturers, wholesalers, retailers, bankers, accountants, and others,—and a large majority of these men was in favor of the change. Because of the importance of the question the Bureau endeavored to give full weight to the arguments on both sides and to look at the question from all angles. Its decision was not hastily reached. After prolonged and careful con-

sideration it concluded that the change was advisable not only from the point of view of research work, but also on broader grounds of general business policy and public interest.

In discussing this question it is necessary that a clear distinction be made between "expense" and "expenditure." Inasmuch as no outside liability is incurred or expenditure made for proprietor's salary or rent of owned store, some accountants believe that no specific charges should be made for these items as expense. The "net profit" shown by subtracting total expense, exclusive of these items, from gross profit includes compensation for proprietor's time; rent for his store, if owned; interest on his investment; and a final net profit as a reward for the risks which he assumes, and for his proficiency in managing the business. Under such a method it is left to the proprietor to compute these four items for comparison with the total "net profit." As a matter of practice, many proprietors who follow this plan do not make even a mental computation and frequently fail to realize that their businesses are not yielding them the returns to which they are entitled. Those who are opposed to charging the business with proprietor's salary and rent of owned store also consistently oppose the charging to expense of interest on capital owned, but do advise the charging of interest on capital borrowed to expense. It has become more and more commonly agreed, however, among accountants and other business men that it is advisable for each proprietor to charge his business with a salary equal to what he could earn if employed elsewhere, and also to charge as expense rent on an owned place of business equal to the rental for which the premises could be leased. When the Harvard System of Accounts for Shoe Retailers was drafted it was decided to charge rent on owned store and proprietor's salary as expense. There is such diversity in the form of proprietorship and in ownership of premises that figures for expense are worthless unless based on a uniform accounting system providing for just such charges as these. The reasoning in regard to the desirability of including rent of owned store and proprietor's salary in expense applies with equal force to the question of interest on capital owned. No business is truly profitable unless it yields the proprietor not only a salary for his time and rent for his store, if he owns it, but also interest on his investment.

The Bureau, therefore, came to the conclusion that every business, whether or not incorporated, should bear a specific charge for interest on net investment—the amount which the capital could earn if invested elsewhere. It decided, furthermore, that it would be more practicable, from an accounting standpoint, to consider this interest charge a part of expense rather than a distribution of profit.

There are objections to the plan of including interest in expense which deserve the most careful consideration. One of the objections is that rates of interest vary between localities. Yet the fact that interest rates vary is not a valid reason for not including interest in the expense statement. The rate of wages varies; rent varies; and

one of the objects of such research as the Harvard Bureau conducts is to learn the differences in expense for these different items.

Another objection is that the rates of interest also vary between individual concerns. In this connection the proposed plan was criticised on the ground that the interest charge represents an estimate. The determination of the rate of interest to be charged for each business presents some difficulties. The Bureau finally decided, however, to use the ordinary interest rate on reasonably secure, long-term investments in the locality in which the business is situated. In measuring the results of his business, the business man, if he thinks about the subject at all, computes the amount of interest which his capital safely would earn, without his personal effort, in some other form of investment. Inquiries by the Bureau made clear that in each locality a definite idea prevailed as to what constitutes the rate of interest normally to be expected on long-term investments, and therefore influencing the action of the individual investor. The Bureau decided that it safely could use this commonly expected rate. This interest charge is an estimate is not a vital objection. Serious error in the capital invested before it can be considered profitable. The business should earn something more in the way of "profit"; but the subject of profit will be discussed in greater detail later. That the interest charge is an estimate is not a vital objection. Serious error in the determination of this interest charge is not likely. Furthermore, in all cost accounting some apportioning or prorating of items is necessary, and in most of these instances the possibility of error seems to be fully as great, and in some much greater, than in the estimate of the interest charge.

Another objection, and one of some weight, is the difficulty of determining the amount of the net investment. The theoretical difficulty of defining capital was met by the definition which the Bureau adopted. Inasmuch as rent is to be charged as a separate item, the value of land and buildings used in the business is not to be included in this principal sum. Good-will, patents, trade-marks, and other intangible assets are excluded, as are also outside investments in other business or in other property. The items involved in the calculation are:

Assets	Liabilities
Cash on Hand and in Bank	Notes Payable
Notes Receivable	Accounts Payable
Accounts Receivable	Accrued Items
Securities	
Net Inventory of Merchandise	
Net Inventory of Equipment	
Net Inventory of Supplies	
Prepayments	

The valuation of equipment is perhaps the most difficult point in the determination of net investment. A concern which is starting in

business will charge its capital account with all equipment purchased at cost, including transportation charges. At each inventory period a proper amount should be charged to expense as depreciation and credited to this capital account. The balance of the account then represents the net investment in equipment—the original investment, plus additions, less the amount charged to expense as depreciation. A going concern which has not followed this method should make a valuation of its equipment at the amount which that equipment is actually worth, and then depreciate that amount properly at each succeeding inventory period. In so far as the charging of interest to expense encourages better accounting for actual investment and proper depreciation of equipment, the Bureau believes this step is highly advisable. The amount of the net investment must be determined, in the case of corporations, entirely irrespective of the amount of capital stock authorized or issued; the capital stock may be much in excess of the real investment, or, on the other hand, the business may be undercapitalized.

The objections raised by those opposed to the inclusion of interest in the expense statement are founded upon a conception of net profit which makes "net profit" a residual item including both interest and profit. The Bureau believes that from all points of view it is desirable that a distinction be made between interest and profit. It is granted by those who consider interest and net profit as synonymous, that the proprietor of a business rightfully expects the business to yield him something more than the salary which he could earn if employed by another, rent on his store, and interest on his capital. It is this additional profit which induces him to engage in business on his own account. It compensates him for his own proficiency in organizing and managing the business and for the extra risks which he incurs as proprietor and investor. The "profit" earned in one year counterbalances the loss of another year, and, considering the industry as a whole, the "profit" earned by one business counterbalances losses incurred by others of the same sort.

This item of "profit" is purely residual; it is quite distinct from interest; and it is to be justified on entirely different grounds. From the point of view of the individual business man, full recognition of this distinction between interest and "profit" is desirable, in order that he may judge more fairly the results of his efforts. From the point of view of public advantage it is unquestionably desirable that entrepreneur ability should be stimulated and encouraged, and that the justification of "profit" over and above interest should be recognized. It is a mistaken notion that high profit is necessarily or even commonly the result of extortion. Good quality and service to the public and good wages to employees are not in the least inconsistent with a high "net profit" produced by exceptionally able management. The public and employees are, in fact, more likely to suffer under poor management and small profit than under good manage-

ment and large profit. The inclusion of interest in expense brings out the fact that capital is entitled to definite returns, and that each business should yield a profit over and above interest, rent, and salaries.

The following is a copy of the report of the special committee of The American Institute of Accountants on "Interest in Relation to Cost." [1]

Gentlemen: Your committee on "Interest in Relation to Cost" has had one long meeting at which it had the benefit of the extreme views of Mr. Clinton H. Scovell, the sponsor for those who advocate the inclusion in production cost of interest on investment, in which Mr. Scovell very fully set forth the views of those who favor such procedure. The views of the committee on this question, which are at variance with those of Mr. Scovell, may be, as to certain points, briefly stated as follows:

There has been a great deal written and said on this subject, much of which is purely academic, but a practical, concrete definition of cost is "Expenditure for production." Interest on investment is not an expenditure, but is at best only an anticipation of profits and, as such, has no logical standing in the computation of production cost.

If the theory is applied in practice, it is necessarily an arbitrary calculation, based not upon any established fact but upon someone's vision of what particular interest rate would be properly applicable in the premises, and, after the amount is so determined, injected into the calculations of actual expenditures, and so added to assets.

The inclusion of interest on investment as a part of the production cost must result in one or the other of two conditions:

First, a false statement of assets and income; or

Second, the creation of a reserve account, estimated to be equal to the amount arbitrarily added to the assets and the income.

It is, of course, assumed that no accountant would wish to present a false statement of the assets and income of any concern, and, therefore, only the question of the creation of a reserve to offset the suggested artificial inflation of the assets remains to be considered.

As such, in a statement of assets and liabilities, it must be deducted from the valuation at which materials and supplies, finished goods on hand and in process, and any other items included in the inflation, are carried in the books. If not actually deducted on the face of the balance-sheet, a person having knowledge of finance and accounting (for instance, a banker) will mentally deduct this reserve in forming his opinion of the value of the assets. Hence the work and trouble expended in the calculation is futile so far as a statement of assets and liabilities is concerned, and only leads to confusion instead of simplicity.

[1] *American Institute of Accountants' Yearbook*, 1918, page 110.

The credit account or reserve which is set up as a contra to the debit included in cost can be kept in equilibrium only by a periodic calculation of the amount of the false or arbitrary figure that has been included in the cost of goods sold; which amount must be first estimated, for it could never be determined definitely, and then debited to the reserve and credited to profit and loss, to offset the amount of such items that were, prior to sale, included and carried in cost. Hence the additional expensive detailed bookkeeping is entirely futile in that it has no eventual effect in a true statement of profit and loss.

Having no final effect upon either the balance sheet or the profit and loss account, except to confuse them, it is of no value whatever in a statement of condition or results. The suggested practice reminds one of the hillside exploits of the "Gallant Duke of York" and his famous 10,000 men.

Under the federal tax law one is not permitted to deduct from profits reserves for inventories, and so forth, and no matter how patriotic one may be, any accountant who would recommend to a client that he arbitrarily and artificially increase his profits, in order that he may pay as high as 80% thereof to the Government, must have great faith in the childlike simplicity of human nature.

But the advocates of the practice say that it is a necessary item in the determination of the selling price. But even if so, why include it in production cost? It is no more necessary to that end than numerous other items which must be taken into consideration in establishing a selling price, provided the state of the market would afford a selling price based upon such a computation instead of on supply, demand, and competition. For instance, such a calculation involves expenses of selling, expenses of administration, expenses of financing, and expected profit. No one would seriously advocate the inclusion of all these items in cost, and if they must be calculated "on the side" and added to the production cost in order to determine a selling price, there seems to be no logical reason why the "side" calculations should not include the entire desired profit in one motion. It only complicates the calculation first to include a portion of the profit in production cost, and then again to deduct from the total expected profit the anticipated portion (another estimate) previously absorbed. This is only another instance of the futility of the practice.

One of the supposed minor claims of the advocates of the practice is that it is necessary in order to establish a comparison of cost with others in like business, or the different plants of the same concern under different conditions of investment. That argument is hard to follow, and there are always other elements of difference that the item of interest on investment would not equalize. Furthermore, when those others with whom it is desired to compare costs are competitors, one is not likely to know their methods of computing costs or the elements involved, and, therefore, comparison is impossible, whether or not interest on investment is used as an element by them.

In conclusion, it is the opinion of your committee that the inclusion

in production cost of interest on investment is unsound in theory and wrong, not to say absurd, in practice.[1]

Respectfully submitted,

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CHARLES S. LUDLAM
W. B. RICHARDS
A. PYOTT SPENCE
SEYMOUR WALTON
Committee

Professor W. M. Cole writes as follows[2] on this subject:

Interest as Cost of Production. Much has been written of late about the relation of interest on investment—as investment in machinery, in stores carried in the storeroom, and so forth—to costs. This is no place to argue the matter, and the argument heretofore published indicates that to a great extent people who differ are talking about different things, and, obviously enough, cannot be brought to a common ground by any discussion here. One thing does concern us here, however, and any theory which neglects it is in practice dangerous, however interesting or however futile it may be as economic speculation; to attempt to compare the cost of two products, one of which is made largely by machinery and the other of which is made chiefly by hand, and omit from the comparison all recognition of invested capital, is to run the risk that the figures, of which the purpose is to make comparisons, will be incomparable and hence misleading. If two products cost each $5 for raw material and $8 for labor and $2 for burden,[3] exclusive of interest on the value of investment used, but one is made wholly by hand and the other involves the use of a machine costing $500, it is nonsense to say that, for any purpose for which accounts are kept, the two products are reported comparably when we say that each cost $15 only. The purpose of cost finding is quite as much comparative as absolute. If the products cost the same, they may be sold for the same figure and yet yield the same profit. Then a sale of one for $18 means the same thing as a sale of the other for $18. If that is

[1] When the report of the special committee on interest in relation to cost was discussed at the meeting it was resolved that a footnote should be published with the report, to the effect that while the views of the committee were approved, it might be added that every accountant would admit that the inclusion of interest in cost for purely statistical and internal purposes might have a value. The report being concerned only with the accounting and financial side of the question, did not discuss the unimportant subject of the compilation of intra-company statistics not intended for other than private use. Adoption of the report did not debar any member from including interest in cost of production when compiling such internal statistics—provided always that such statistics must not be used to color financial statements.

[2] *The Fundamentals of Accounting*, p. 399.

[3] The burden in the machine-made product includes, of course, maintenance and depreciation of machines, so that capital has not been depleted.

true a man whose product costs $15, though he used machinery and does not count it, should sell his goods at the same price as one whose product costs $15 without using machinery. If reply is made that the cost is the same for the two articles, but one must yield more profit than the other because the owner of the machine must meet not only costs but additional profit to cover the use of his investment, the dispute is merely over the use of terms, cost vs. profit; but in that case it is admitted that the $15 figures for the two products are not comparable, for one product needs to have added to it profit of one magnitude, and the other profit of another. Yet one of the purposes of our cost accounting is to get comparable figures—figures that enable us to see what prices must be obtained for various products to make them worth our making, or, if prices are independent of our operations, what articles we can and cannot afford to make. Yet, if after we have got our comparative figures we must go over them again and calculate different rates of profit to be added to different articles to bring them up to necessary standards of selling price, we have vastly increased our labor for the mere sake of maintaining a point of pure theory about the relation between cost and profit (virtually every well-known economist considers interest as a cost). The convenient thing, the natural thing by cost-accounting methods, the thing which accords with economic terms and usage, is to treat interest on investment as (1) one of the debits to operation, so that we may make comparisons between different articles of production by putting them on the same basis, and (2) one of the credits to income on investment in the business. The effect of this is to charge product, through burden (particularly through machine rates, and virtually all machine-rate calculations in use include interest on the investment in the machine), and to credit Interest Earned; a cost of production (and hence a reduction of profits below what they would be if interest were neglected) offset by income on investment—a charge to one department of the business, so to speak, by another department, and producing comparable figures of production in the department charged.

What "different things" are commonly discussed in an argument about interest as a cost? What is your opinion in each case?

Do the Harvard Bureau of Business Research Bulletin and Professor Cole refer to the same matter in their arguments? Does this affect their conclusions? [1]

[1] A vote of the members of the National Association of Cost Accountants, reported in their Bulletin of Aug. 15, 1922, p. 337, shows the following:

Question. Do you believe that interest on investment should be included as an element of cost?

Answer. No: 450. Yes: 106.

Question. Do you believe that interest on investment should be included as an element of cost in the same manner, and with the same effect, as the other factors of cost as to which there is no dispute?

Answer. No: 477. Yes: 79.

20. HATTON MANUFACTURING COMPANY—BASIS FOR COMPUTING INTEREST AS A COST

The Hatton Manufacturing Company owns a factory which is subsidiary to its main factory and located some 200 miles away from it. In figuring manufacturing costs in the subsidiary factory the head office charges it with 6% interest upon the investment in the buildings and equipment.

At first this interest was computed upon the original cost of the assets. The buildings were, however, being depreciated upon the basis of a 25-year life, and the machinery upon the basis of a 15-year life. The manager of the subsidiary factory contended that this depreciation was equivalent to returning part of the capital investment in his factory to the head office, and that the actual investment was thereby reduced. He argued that he should be charged interest only on the net depreciated value, and not upon the original cost.

The head office replied that the buildings and machinery of the subsidiary factory were being maintained in first class repair, so that the manager was continuously enjoying the same facilities for production as at the beginning; they argued, therefore, that there was no reason why the charge for interest should be diminished.

To this the manager rejoined that the calculation of interest upon investment was a financial question having nothing to do with the facilities which he enjoyed. He said that the only question at issue was as to how much was the investment upon which he should be charged 6%, and he favored the depreciated figure.

The head office answered that the total charge being made to the subsidiary factory was in the nature of a rent—analogous to a rent that might be charged to any householder. Such rent would include a charge to cover interest on investment, repairs, depreciation, taxes, and insurance; and such total rent would not ordinarily be subject to gradual reduction with the age of the building, provided the building were kept in good repair. They declined, therefore, to make any reduction in the annual charge to the subsidiary factory.

What should be the basis for charging interest on investment in the building and equipment of the subsidiary factory, assuming that it has been agreed that 6% shall be charged for this purpose?

E. POWER COSTS

21. HENNEPIN CHEMICAL COMPANY—COLLECTION AND DISTRIBUTION OF POWER COSTS

In order to have a check on the efficiency of the power department, to prevent waste, and to control the operation of the plant, the factory manager of the Hennepin Chemical Company has asked for monthly statements showing the following facts: (1) the cost of generating steam; (2) the cost of distributing steam; (3) the cost of generating electricity; (4) the cost of manufacturing compressed air; (5) the cost of supplying salt water; and (6) the distribution of these expenses to the manufacturing and non-manufacturing departments. The data for last month's operations appear below.

The value of supplies, which can be issued from the storehouse only upon requisitions approved by the foremen of the departments, is $6,634.13. Requisition slips are made in duplicate, the original being filed by departments and the duplicate by articles. An analysis of these slips shows the following facts:

Supplies issued for plant construction	$ 780.60
Supplies issued for repair work	2,307.17
Supplies issued to manufacturing and expense departments	3,132.50
Supplies issued to steam-generating department	17.65
Supplies issued to steam-distributing department	21.12
Supplies issued to electricity-generating department	375.09

The supplies issued to the electricity-generating department include lubricating oil which cost $357.37.

From past experience it has been found that the total yearly cost of freight on supplies, handling expense, and storehouse expense, including fixed charges on the storerooms and salaries of storekeepers, is about 10% of the value of supplies issued from the storehouse during the year. Since the value of supplies used for plant construction and repair work is normally about one-half of the value of all supplies consumed, these expenditures are absorbed by adding 10% to the value of the supplies issued for this purpose, and by prorating the remainder to the supplies used by the manufacturing and service departments. When the market is rising, supplies may be purchased six months in advance. All inward freight and handling expenses, however, are

charged to production in the month in which the supplies are received, since the advantage to be gained from a more exact prorating is not considered great enough to justify the additional cost. The total of these expenses chargeable to supplies this month is $1,061.67.

An analysis of the payroll shows salaries and wages to be chargeable as follows:

Department	Salaries	Wages
Steam-generating department	$214.89	$525.07
Steam-distributing department	138.89	
Electricity-generating department	138.88	523.54

As repairs vary in different periods, a standard amount is charged each month to make costs more uniform. Each month Manufacturing Expense is debited and Reserve for Repairs is credited for the standard amount. When an expenditure for repairs is made, Repairs is debited and Cash credited. In order to make the Repairs account and Reserve for Repairs balance each year, the last month of the year is charged or credited with the exact amount necessary to balance, which may be either a smaller or greater amount than the standard. The monthly charge for repairs for the steam-generating department is $500; for the steam-distributing department $17; for the electricity-generating department $750; and for the compressed air department $17.

Depreciation is charged on a yearly percentage basis of 5% on buildings and 7½% on equipment. The depreciation schedule gives the monthly depreciation in the steam-generating department as $240; in the steam-distributing department as $253; in the electricity-generating department as $234.50; and in the compressed air department as $143.

The year's taxes on both buildings and equipment, which are known in advance, are prorated according to the value of the equipment in the various departments. The monthly charge is $100, $95, $105, and $55 for the four departments respectively.

Two kinds of insurance are chargeable to power. Since the power department buildings are all fireproof, no fire insurance is carried. The premium on explosion insurance on boilers and engines used to generate steam is $3.70 a month; on the steam

piping used for distributing steam $3.35; on the steam engines in the electric department $14.24; and on the air tank $5.66. The charge for workmen's compensation insurance is $2.70 per capita per month. There are 17 men in the steam-generating department and 16 men in the electricity-generating department. The supervisor of power divides his time between all the departments, but for practical purposes the cost of his insurance is divided equally between the steam-generating and electricity-generating departments.

A physical inventory of the fuel oil used to generate steam shows that 135,183 gallons were used at an average price of $.044966 per gallon, or $6,078.64. Of the laboratory expense for the month, $20.20 is chargeable to the compressed air department.

Water is purchased from the city at 80 cents per thousand cubic feet. The total shown by the company meter readings is subtracted from the total number of cubic feet indicated by the city's meter. The difference or leakage is charged to general expense which is prorated to the product on the basis of manufacturing labor costs. Fresh water, unlike steam and electricity, is metered into every department. The meter readings for the month are shown below:

Manufacturing	Cubic Feet	Non-Manufacturing	Cubic Feet
Alum	3,670	Carboy Shed	906
Ammonia, Aqua	22,210	Carboy Washing	10,500
Muriatic Acid	6,317	Laboratory	9,049
Oil of Vitriol, Chambers	14,400	Office	5,000
Oil of Vitriol, Contact	50,023	Locomotives	25,300
Sodium Sulphite, Liquor	1,670	Crane	15,000
		Steam Boilers	260,000
		Leaks	235,095
	98,290		560,850

The salt water, which is used principally for refrigeration, is pumped from the ocean. For practical purposes, the pump is considered a part of the equipment of the electric generating department, thus making the cost of electricity used in pumping the only charge for salt water. Compressed air is used principally to transport products between departments; all acids,

for instance, are blown through lead pipes instead of being transferred in containers. The cost of salt water and the cost of compressed air are charged to the departments according to percentage estimates based on production. These percentages which are determined monthly by the engineering staff, are given below.

Department	Percentage of Salt Water	Percentage of Compressed Air
Alum	10%	20%
Ammonia, Aqua	20%	15%
Oil of Vitriol, Contact	20%	20%
Oil of Vitriol, Chambers	35%	25%
Muriatic Acid	15%	10%
Sodium Sulphide, Liquor		10%
	100%	100%

A summary of the daily power reports indicates that 11,550,000 pounds of steam were generated during the month, of which 10,570,000 pounds were furnished to the steam-distributing department; 825,000 pounds were furnished to the engines in the electric generating department; and 155,000 pounds were furnished to the engine in the compressed air department. The unit of cost is 1,000 pounds of steam. Four Bailey steam meters are used to measure the steam used by the alum department, the ammonia department, the general heating plant, and by the engines in the electric generating department. The meters are attached at the department, and consequently any loss from radiation in the distributing pipes is neglected. The consumption of steam by the other departments is estimated from actual production; tests are made from time to time by metering steam into the department for several days to determine the amount required per ton of product. The steam used to heat the non-manufacturing departments is estimated on the basis of cubic space occupied.

The engineer's report gives the distribution of the steam furnished to the steam-distributing department as shown on page 301.

According to the power summary, 90,500 kilowatts were generated during the month. As in the case of steam, the amount of electricity consumed by the important production centers is

Manufacturing	1,000 lbs.	Non-Manufacturing	1,000 lbs.
Acetic Acid	18	Carboy Shed	125
Alum	2,306	General Heating	
Ammonia, Aqua	2,230	Laboratory	500
Ammonia, Anhydrous	105	Office, Adm.	250
Ammonia, Sulphate	2,750	Storehouse	400
Muriatic Acid	36	Rest Rooms	135
Oil of Vitriol, Chambers	560	Shops:	
Oil of Vitriol, Contact	310	Carpenter	165
Sodium Sulphide, Liquor	250	Cooper	90
		Electrician	75
		Machine	75
		Pipe	135
		Plumber	75
Total	8,565	Total	2,025

metered, but the consumption of electricity in other departments is estimated on the basis of production, tests frequently being made to determine the amount of electricity required per ton of product. The number of kilowatts consumed in each department is stated below.

Manufacturing	Kilowatt-hours	Non-Manufacturing	Kilowatt-hours
Alum	13,000	Shops:	
Ammonia, Aqua	1,500	Carpenter	1,500
Ammonia, Sulphate	1,500	Machine	1,500
Muriatic Acid	7,500	Pumping Salt Water	16,000
Oil of Vitriol, Contact	41,500		
Oil of Vitriol, Chambers	6,000		
Sodium Sulphide, Liquor	500		
	71,500		19,000

22. NEWGATE ELECTRIC COMPANY—ACCOUNTING FOR ELECTRIC LIGHT AND POWER

The coal which is received by Newgate Electric Company[1] on its own railroad sidings at an average rate of two or three 45-ton cars per day, is shipped from the mine by water to

[1] The Newgate Electric Company supplies 17 medium-sized New England cities and towns with electric light and power. Its plant is modern and efficient, and its management is constantly endeavoring to provide good service. The power station, which is not over 15 years old, is located adjacent to a river in a very

Providence, whence it is forwarded by rail. Upon arrival it is either dumped into a building with an open top, preparatory to being carried immediately on a belt conveyor to the bunkers above the boilers, or it is dumped into large bins in the yards for storage. These bins are capable of holding over 10,000 tons, which is sufficient to last for approximately three months. When the coal is needed, a locomotive crane loads a car which carries the coal from the bins to the belt conveyor, where it is unloaded by the same crane. The railroad weights are accepted on the coal, subject to periodic checks made by running the cars over the company's own track scale. The plant is given a 4% allowance for shrinkage by the home office.

At the end of each month, or, if coal has been received from several shippers, upon the arrival of each shipment, a sample of coal is collected by taking small portions from different parts of the pile or cars. After crushing, to insure thorough mixture, two quarts of the sample are sent to a Boston chemist for analysis for British thermal units. A coal clause inserted in contracts with purchasers of power calls for adjustment of the price of electricity on a basis of coal of 14,800 British thermal units per pound dry.[1]

small town. Since the territory in which it is situated is one where business and population are constantly growing, it is frequently necessary to add new and larger units of machinery to replace those which are smaller and less efficient. More land is available, and the buildings are designed to permit the construction of additions.

[1] Coal Clause—Whenever during the continuance of this agreement the cost to the Power Company of Pocahontas, New River or other coal of equivalent grade of approximately 14,800 B. t. u. per pound dry, is more than $5 per ton of 2,240 pounds (this cost to include delivery in the Power Company's storage, and to be the average price for all coal carried in said storage, together with coal received from time to time) for any period exceeding three consecutive months, then for each five cents increase in cost over and above $5 per gross ton, the Purchaser will pay an additional amount of $0.00006 for each kilowatt-hour of electric energy used during said three months, and during the period that said cost of coal exceeds $5 per gross ton.

Whenever during the continuance of this agreement the cost to the Power Company of Pocahontas, New River or other coal of equivalent grade of approximately 14,800 B. t. u. per pound dry, is less than $4.25 per ton of 2,240 pounds (this price to include delivery in the Power Company's storage, and to be the average price for all coal carried in said storage, together with coal received from time to time) for any period exceeding three consecutive months, then for each five cents decrease in cost below $4.25 per ton, the Power Company will reduce its price $0.00006 for each kilowatt-hour of electric energy used during the said three months, and during the period that said cost of coal is less than $4.25 per gross ton.

If the quality of the coal purchased by the Power Company differs from that above specified, the average cost of coal determined as aforesaid shall be corrected to an equivalent of 14,800 B. t. u. per pound dry.

When such coal, or its equivalent, costs the company for three consecutive months more than $5 per gross ton delivered, the purchaser of power pays $.00006 additional for each kilowatt-hour of electric energy used during the said three months, and during the period that the cost of coal continues to exceed $5 per gross ton. Consequently the manager is interested in the amount of coal required to produce a kilowatt-hour of electricity. Recent shipments have averaged over 14,000 British thermal units per pound dry.

Previous to entering the belt conveyor, the coal passes through two large spiked iron cylinders, between which it is crushed. It is then carried to large bins above the 10 boilers. A larry, which travels on overhead tracks and has in general the appearance of a large funnel, is brought under the coal containers and the desired amount of coal is allowed to descend by gravity into its mouth. The larry is then moved along the tracks until it is in a position to feed any one of the boilers. Since coal is weighed in the larry, the amount of coal fed to each boiler is always known.[1]

After the coal is burned, the ash is dumped mechanically into pits under the boilers; it is then shoveled by hand into hand cars, and taken to the scales to be weighed before being dumped into an adjacent pit. From the pit it is moved by the locomotive crane to a large pile, where the ashes are allowed to remain until they are sold eventually as road-making materials. This method is costly and should be improved, but as yet no adequate solution has been found for the problem. At present, five men use all their time in storing the coal within the plant, and a larger crew is engaged in tending the boilers and carting ashes. It has been the practice to charge all costs of handling and transporting coal to the storage points within the plant, together with the purchase price, to an account called "Boiler Fuel."

The company obtains its water from the river on which its plant is located. The river has been dredged, so that cool water, a necessity for condensing, is obtained from a depth of five or six feet. The water is metered as it comes from the river, and excepting that used for condensing, it goes through

[1] Coal consumed by the plant during the first five months of 1923 amounted approximately to 7,000,000 pounds in January; 6,000,000 pounds in February; 7,000,000 in March; 6,000,000 in April; and 6,000,000 in May. In the boilers the coal is burned at a temperature frequently reaching 3,000° Fahrenheit.

a purification process and afterwards passes into a pond with an especially prepared clay and gravel bottom, where it is kept ready for use. From this reservoir it is pumped to a tank on the top of one of the buildings, from which it flows to those places where it is needed. Water being used for condensing is piped directly from the river, and, after being used, is discharged farther down stream; whereas that which has been used for steam is condensed and returned with comparatively small loss to the boilers.

The steam, which is generated by the boilers, passes through large pipes into turbines which have generators coupled to them. The 13,000 volts is produced, metered, and sent over the wires from the power station to distributing substations where it is transformed to 2,200 volts prior to being sent out to the streets where it is again transformed to 550, 220, or 110 volts, before being consumed for power, heat, or lighting. At each stage, a check is kept of progress by means of meter readings which are forwarded each day to the home office. It is necessary to have a crew of men to oil, wipe, and repair the generating machinery, and another crew to tend the electrical apparatus. The plant superintendent sends estimated monthly costs, based on the figures, charts, and experience of the past 10 years, to the plant, where they are compared carefully with the actual outlays.

The power plant has numerous peak loads for which provision must be made. It has been found that most power is used between 8:30 a. m. and 4:30 p. m., although an intermediate falling off at noon is apparent. In the early hours of the morning practically the only use of electric power is for the street lighting; in the evening, home and street lighting are the principal uses of power, although pumping of sewage at night is resorted to in order to assist in leveling out the load. Generally the amount of power required increases from Sunday to Wednesday, but decreases gradually during the remainder of the week. The plant is called upon for a heavier production during the short days of winter than during the summer days. July is usually the month of smallest power consumption. The fact that the management is making a constant endeavor to increase the load factor in times of minimum use is one of

the reasons that it maintains a salesroom for smaller electrical appliances.

Repair parts for the mechanical stokers, which are an important item, are made to order at a nearby foundry, partly to save transportation charges, but largely because the foundry has been found to be efficient and has cooperated with the plant in its endeavors to provide continuous and satisfactory service. Other parts, which are sent by the home office, are charged to the plant's fixed investment or to an account for supplies on hand. In the latter case, they are kept under a lock and key at the station and issued only by the assistant chief engineer. A book inventory is kept, which always agrees with the physical count, since the stock is small enough to permit its being under the personal supervision of the higher employees. In order to have repairs made promptly, a small machine shop is maintained at the plant.

The men work on eight-hour shifts six days a week. Two weeks' vacation and two weeks' sick leave, both with pay, are allowed annually to each employee. No man leaves his post unless his relief has reported to him. Time clocks are unnecessary, as it has been found that employees complain more than do the higher officers about a relief being a few minutes late. The men's time is reported by the assistant chief engineer to the cost clerk, who in turn sends to the home office on a regular form a report signed by the chief engineer, designating the work performed each week so that the accounts to which the labor should be charged can be readily ascertained. All labor is direct with the exception of that of the superintendent, plant manager, chief engineer, assistant chief engineer, cost clerk, and the service rendered the plant by the accounting department at the home office. The cost clerk brings the money to the plant on Wednesday, at which time the men are paid for the preceding week, and the signed receipts are sent to the home office.

A small crew of men, which is on constant duty at each of the eight substations to read the meters and tend the electrical equipment, work under the direction of the foreman who is in charge of sending the energy from the power plant. Since the electricity is metered upon its arrival at and departure from each substation, the amount lost in transit and within the sta-

tion is known. Each substation sends a large daily report to the home office.

Construction and maintenance of lines and equipment is taken care of by a special gang. Automobiles, which are provided to carry the men over the territory so that emergency repairs may be made with dispatch, are housed on the company's premises at the substations.

23. THE FOWLER FLOUR MILLS—COST ACCOUNTING WHERE THREE KINDS OF POWER ARE AVAILABLE

The six mill units of the Fowler Flour Mills are operated by water, steam, and electric power. There is no central power station. Four mills are equipped to run on water-power alone, steam alone, or a combination of the two. Another mill is equipped to run on water-power alone, or on a combination of water-power and electric power. Another unit can be operated only with electricity. The Fowler Company wants to develop an accounting system for its power department which will provide the following three things: first, the cost of operating each mill with each kind of power; second, a record of the efficiency of each power unit; and third, the average cost of power per barrel of flour irrespective of the mill which produces it.

Although water-power is the cheapest, there is seldom enough water available to operate five mills on water-power at the same time. If all these mills are operated, one of them must be driven with steam-power, which is almost twice as expensive. It is not considered fair to charge the head miller of Mill A with the total cost of steam-power, when he is deprived of water-power because the other mills are using all that is available.

The statistics which follow summarize the existing conditions, and give the operating statistics of the individual mills for a 10-year period.

SUMMARY OF POWER DATA *

Mill	Number of Days of Use in Mills					
	A	B	C	D	E†	F
Kinds of Power Used						
Water	125	105	266	107		206
Steam	124	51		82		37
Electricity					278	
Water & Steam	11	113		80		24
Water & Electricity			59‡			
Total days operated	260	269	290	269	278	267
Number of days idle	105	96	75	96	86	98
Percentage of idle time	28.8	26.3	20.9	26.3	24.1	26.8
Wheat flour produced, barrels, (hundreds omitted)	899.7	1,349.3	558.4	1,521.5	1,135.5	526.6
Maximum daily capacity, barrels	3,500	6,000	2,200	6,000	4,200	2,100
Average actual daily production, barrels	3,460	5,020	1,930	5,670	4,090	1,970

* The figures are a yearly average of operation for 10 years, 1909-10 to 1918-19. The fiscal year is from August 1 to July 31.

† A six-year average. Mill E was rebuilt in 1913 and its capacity was increased.

‡ This figure is only a four-year average. The motor was not installed until 1915. The total number of days operated is not therefore the sum of the number of days operated on water-power and the number of days operated on electricity. The former is a ten-year average, and the latter a four-year average.

MILL A

	Number of Days Each Kind of Power Was Used					
ar	Water	Steam	Water and Steam	Number Days Operated	Number of Days Idle	Barrels of Wheat Flour Produced
1909-10	151	108	26	285	80	972,600
1910-11	33	196	5	234	131	910,900
1911-12	48	251	0	299	67	916,200
1912-13	86	202	9	297	68	913,400
1913-14	164	94	9	267	98	912,900
1914-15	148	100	0	248	117	820,500
1915-16	185	49	47	281	85	1,118,600
1916-17	204	17	0	221	144	718,700
1917-18	153	105	10	268	97	713,100 *
1918-19	80	116	3	199	166	747,300
Average	125.2	123.8	10.8	259.9	105.3	899,700

* In 1917-18, 12,800 barrels of rye flour and 246,200 barrels of barley flour were produced. The output per day is decreased on coarse grain. This mill will grind only 65% as much rye flour as it will wheat flour and 50% as much barley flour.

Maximum capacity on wheat, 3,500 barrels per day

Actual production, daily average, 3,462 barrels

Horse-power requirements:

Milling 1,035 h. p.
Grain cleaning 200 h. p.

Power Equipment:

One steam engine, 1,200 rated h. p.
One water wheel, 1,575 rated h. p.
One electric motor, 200 rated h. p.
Twelve auxiliary motors, 45.5 rated h. p.

MILL B

Year	Number of Days Each Kind of Power Was Used: Water	Steam	Water and Steam	Number of Days Operated	Number of Days Idle	Barrels of Wheat Flour Produced
1909-10	90	5	189	284	81	1,349,500
1910-11	44	102	147	293	72	1,377,400
1911-12	76	98	52	226	140	1,033,400
1912-13	113	138	52	303	62	1,473,500
1913-14	158	18	109	285	80	1,424,000
1914-15	161	19	67	247	118	1,204,600
1915-16	41	3	253	297	69	1,770,400
1916-17	147	5	86	238	127	1,116,500
1917-18	116	67	115	298	67	1,567,600
1918-19	103	51	59	213	152	1,174,300
Average	104.9	50.6	112.9	268.4	96.8	1,349,000

Maximum capacity on wheat, 6,000 barrels a day

Actual production, daily average, 5,023 barrels

Horse-power requirements:

Milling 2,000 h. p.
Grain cleaning 400 h. p.

Power Equipment:

One steam engine, 1,600 rated h. p.
One water wheel, rated h. p. 1,145
One water wheel, rated h. p. 831 1,976
One motor, 200 rated h. p.
Eight auxiliary motors, 20 rated h. p.

MILL C

Year	Number of Days Operated Water	Water and Motor	Total	Number of Days Idle	Barrels of Wheat Flour Produced
1909-10	285		285	80	461,400
1910-11	290		290	75	431,200
1911-12	281		281	85	477,400
1912-13	301		301	64	584,000
1913-14	286		286	79	594,200
1914-15	280		280	85	519,100
1915-16	258	41	299	67	731,200
1916-17	232	56	288	77	496,900
1917-18	258	54	312	53	685,600*
1918-19	188	85	273	92	602,900
Average	265.9	59.0	289.5	75.7	558,400

* In 1917-18, 146,600 barrels of barley flour and 49,300 barrels of corn flour were ground. This mill can grind 50% as much barley as wheat, and 54% as much corn. The figure shown is reduced to barrels of wheat flour.

Maximum capacity on wheat, 2,200 barrels a day; on durum wheat, 1,700 barrels a day

Actual production, daily average, 1,930 barrels

Horse-power requirements:

Milling and grain cleaning combined, 900 h. p.

Power Equipment:

One water wheel, 845 rated h. p.
One electric motor, 150 rated h. p.
Five auxiliary motors, 29 rated h. p.

MILL D

	Number of Days Each Kind of Power Was Used					
Year	Water	Steam	Water and Steam	Number of Days Operated	Number of Days Idle	Barrels of Wheat Flour Produced
1909-10	129	7	158	294	71	1,848,200
1910-11	65	88	139	292	73	1,682,100
1911-12	119	120	44	283	83	1,587,400
1912-13	111	140	35	286	79	1,694,100
1913-14	143	61	78	282	83	1,369,700
1914-15	135	89	17	241	124	1,127,800
1915-16	70	78	154	302	64	1,760,800
1916-17	101	0	124	225	140	1,374,900
1917-18	95	126	22	243	122	1,364,500
1918-19	97	110	26	233	132	1,396,700
Average	106.5	81.9	79.7	268.1	97.1	1,521,500

Maximum capacity on wheat, 6,000 barrels a day

Actual production, daily average, 5,677 barrels

Horse power requirements:

Milling 2,000 h. p.
Grain cleaning 550 h. p.

Horse-power requirements:

Two water wheels, 745 rated h. p. for each.
One steam engine, 2,000 rated h. p.
One motor, 400 rated h. p.
One motor, 150 rated h. p.
Two auxiliary motors, 2 rated h. p.

MILL E
Only Electric Power Is Used by This Mill

Year	Number of Days Operated	Number of Days Idle	Barrels of Wheat Flour Produced
1909-10	260	105	616,100
1910-11	288	77	591,000
1911-12	308	58	587,100
1912-13	293	72	665,500
1913-14	286	79	1,107,100
1914-15	276	89	1,124,700
1915-16	289	77	1,317,500
1916-17	270	95	1,154,700
1917-18	295	70	1,170,600 *
1918-19	249	116	1,001,300 †
Average ‡	277.5	87.7	1,135,500

* In 1917-18, 328,900 barrels of corn flour were ground. This mill can only grind 50% as much corn as wheat. The figure shown is reduced to barrels of wheat flour.

† In 1918-19, 100,500 barrels of corn flour and 26,500 barrels of rye flour were ground. This mill can grind only 65% as much rye as wheat. The figure shown is reduced to barrels of wheat flour.

‡ A six-year average. This mill was rebuilt in 1913 and its capacity increased.

Maximum capacity on wheat, 4,200 barrels a day

Actual production, daily average, 4,090 barrels

Horse-power requirements:

Milling	1,000 h. p.
Grain cleaning	300 h. p.

Power Equipment:

Three electric motors, rated 1,000, 200, and 100 h. p. respectively

MILL F

Year	Number of Days Each Kind of Power Was Used: Water	Steam	Water and Steam	Number of Days Operated	Number of Days Idle	Barrels of Wheat Flour Produced
1909-10	202	25	30	257	108	543,900
1910-11	169	86	29	284	81	555,000
1911-12	188	80	28	296	70	533,700
1912-13	183	72	51	306	59	560,300
1913-14	232	22	26	280	85	565,600
1914-15	253	28	1	282	83	532,700
1915-16	293	0	10	303	63	648,400
1916-17	186	0	3	189	176	355,700
1917-18	247	22	36	305	60	659,000 *
1918-19	107	36	25	168	197	312,200 *
Average	206.0	37.1	23.9	267.0	98.2	525,600

* In 1917-18, 235,800 barrels of rye flour and 31,300 barrels of barley flour were produced. In 1918-19, there were 43,400 barrels of rye flour produced. This mill can grind only 65% as much rye as wheat and 50% as much barley. The figures shown are reduced to barrels of wheat flour.

Maximum capacity on wheat, 2,100 barrels a day; on durum wheat, 1,900 barrels a day

Actual production, daily average, 1,972 barrels

Horse-power requirements:

Milling and grain cleaning combined, 750 h. p.

Power Equipment:

One water wheel, 1,000 rated h. p.
One steam engine, 800 rated h. p.

The supervisor of power is in favor of working out a system of standard costs. He wishes to charge the power accounts with a predetermined amount of fixed charges and the actual costs of operating the equipment, and to credit each account at a standard rate per barrel of flour produced based upon operations.

The cost of steam power may be divided conveniently into the cost of generating steam and the cost of manufacturing power. Steam produced in the boiler room is delivered through pipes to the engine room where it is converted into power. By this separation of costs, inefficiencies may be localized and their cause more easily eliminated.

As shown by a summary of the equipment, four of the mills have separate power apparatus for grain cleaning, while the other two have their grain-cleaning equipment operated on the same shaft as the mill. Auxiliary motors are used for packing flour and for operating belts and conveyors used in packing and loading. The small motors are a part of the machinery which they operate.

All water-power rights in the river on which the Fowler Company is located are owned by a water-power company. The nature of the water-power lease is such that the charge for water-power may vary at different periods of the year. A summary of the water-power leases is shown below.

WATER-POWER LEASES

Mills	Priority	Mill-Power	Yearly Rental	
A, B, C, & D	5	4	Free	
	14	4	Free	
	20	2	Free	
	26	12	Free	
	29	3	Free	
	35	14	$15,000	
		39		$15,000
F	9	2	$ 400	
	24	1	750	
	34	1½	500	
	47	3½	3,500	
		8		5,150
Grand Total		47		$20,150

Excess water at $6 per mill-power day.* Payments must be made quarterly.

* One mill-power is equal to 75 theoretical horse-power. Because of inefficiencies in the water wheels only from 65 to 70 horse-power are delivered on the drive shaft, and occasionally the horse-power delivered per mill-power is even smaller.

The water leased under priorities 5, 14, 20, 26, 29, and 35 may be used by either the A, B, C, or D mills. Since these mills are located on the same headrace, water used by one will decrease the water available for the others. The priority rights are a necessary protection, when water is low, to the patrons of the water-power company located farther down the river. When the river is low the water-power company notifies all its patrons that a certain priority will be in force until further notice. This

means that anyone who holds a lease with a priority number higher than the one in force, cannot use water. Thus if priority 30 were put in effect, the A, B, C, and D mills would have only 25 mill-power available and the F mill would have only 3 mill-power. According to the agreement, the cost of water which is not available is deductible from the contract price. Whenever a priority lower than 35 is in effect, therefore, the A, B, C, and D mills may still use 25 mill-power, and no charge is incurred.

Steam power is used whenever there is not enough water-power available to operate the mill. When a mill which requires about 2,400 horse-power has only enough water available to develop 600 horse-power, steam power is used to develop the remaining 1,800 horse-power required to operate the mill at capacity.[1] The electricity used by the Fowler Company is purchased from a public service corporation.

What accounts are necessary to accomplish the desire of the management?

F. RETURNABLE CONTAINERS

24. CLAVERLY AND PUGH COMPANY—ACCOUNTING FOR RETURNABLE CONTAINERS

THE Claverley and Pugh Company distributes its sweet-apple cider and vinegar in tight barrels and bottles, which are returnable to the company at the price charged to the customer. The barrels, which cost the company $2 each are billed to the customer at $3. At the time of purchase, an account "Packages—Tight Barrels" is debited with the purchase price. When the barrel is returned, a credit memorandum in favor of the customer is made in duplicate. The original is sent to the customer, who may either apply the credit on another purchase or redeem it in cash. The duplicate credit memorandum with the duplicate invoice is filed alphabetically according to customers.

The average life of a barrel is four trips. After each trip

[1] In other plants it has been found that the saving resulting from operating a steam engine below capacity is not proportional to the decrease in output. It is estimated that if an engine runs at 90% capacity only about 2% in the cost of generating the steam and its conversion into power is saved.

the barrels are inspected; if they show signs of leakage they are sold to a chemical company for $1 each. At the time of sale the following entry is made:

Reserve for Depreciation of Barrels	$1	
Cash		$1
Packages—Tight Barrels		$2

Depreciation on the barrels is included in the cost of cider and vinegar sold in barrels, and credited to the Reserve for Depreciation account at the end of each month at the rate of 25 cents for each barrel shipped. The cooperage charges and other costs of keeping the barrels in usable condition which amount to about 15 cents per trip, also are included in the cost of cider and vinegar sold in barrels. The Maintenance account is debited when the expenditures are made.[1]

The books of the Claverley and Pugh Company have never been audited by a firm of public accountants. Its method of accounting had seemed satisfactory to the management, and, until the depression in 1920, it had not considered the returnable containers a liability. During the last six months of that year

[1] The carboys used by the Hennepin Chemical Company which cost $4 each, are billed to the customer at $5. The average life of a carboy is from three to five years with an average of three to four trips a year. This carboy is good for from 15 to 20 trips. Since the carboys can be used until broken there is no depreciation on them, but each time they are returned they must be unpacked, washed, and sometimes re-branded and outfitted with new caps. All expenses incidental to the maintenance of the carboys, which amount to 26 cents per trip on the basis of an average of 15 trips to a carboy, are charged into one Maintenance of Carboys account. The cost of sales therefore is debited 26 cents for each carboy shipped out, the charge being computed at the end of each month by multiplying this amount by the number of carboys shipped during the month.

At the time of billing the following entry is made:

Accounts Receivable		
Sales		
Returnable Containers, Carboys		

When the carboys are returned, a "carboys received" slip is made out by the receiving department, giving the customer's name. From these slips a credit memorandum is made which is mailed to the customer who may apply the credit either against another purchase or redeem it in cash. At the same time a journal entry is made debiting Returnable Containers, Carboys and crediting Accounts Receivable.

During the World War when the cost of carboys was increased to $5, they were billed to customers at $6. All carboys were branded with the figure "5" or "6" to indicate the price at which they were charged. Two accounts, Returnable Containers—Carboys 5's, and Returnable Containers—Carboys 6's, were kept on the general ledger. No other change in the accounting records was made.

$8,000 was paid for returned barrels, when ordinarily only $3,000 to $4,000 would have been paid out during that period.

What changes should the Claverley and Pugh Company make in its accounts to show: first, the liability for returnable containers in the hands of customers; and, second, the correct cost of sales during each month?

25. THE OAKDALE FEED AND GRIST MILLS—ACCOUNTING FOR RETURNABLE CONTAINERS

Previous to 1917, the Oakdale Feed and Grist Mills were paying from 6 to 8 cents for the burlap sacks in which their feed and oyster shells were shipped. When shipments were made, 10 cents was charged for each sack, to be redeemed at the same price if returned in good condition. When it became evident late in 1917 that a period of inflation would ensue, the Oakdale Company purchased a supply of sacks at 14 cents which it billed and redeemed at 20 cents. In 1919 the price rose to 34 cents, when the company charged and redeemed them for 40 cents.

Usually about 85% of the sacks were returned, but, when the price increased, practically 95% were returned. Some sacks were not returned or were returned in such a condition that no refund was given, and a profit was thereby realized which more than covered the cost of repairing the sacks. Since few sacks were discarded by the Oakdale Company, most of the depreciation was borne by customers. When deflation took place, however, sacks billed at 40 cents were redeemed at that price and later charged to customers at 30 cents or even 20 cents. This writing down of sacks was debited to surplus in the same manner as depreciation of other inventories. All sacks were branded with an identification mark to indicate their redeemable value. As prices changed this mark also was changed.

Since 1922, all sacks are billed at 10 cents, no mark is necessary, and the former method of accounting, which consisted of carrying the value of all sacks charged to customers in a "Returnable Sacks" account, is used. This account is debited when sacks are returned, and credited when they are discarded. The percentage of unreturned sacks is determined by comparing the number of sacks returned with the number of sacks

shipped during the year. The unreturned sacks are charged off by debiting "Returnable Sacks" and crediting Profit and Loss with the difference between the average cost of the sacks and the selling price.

What changes in its accounting should the Oakdale Feed and Grist Mills have made during the period of inflation, and since?

G. MISCELLANEOUS EXPENSES

26. THE BLACKBURN CAR AND FOUNDRY COMPANY—RESERVE FOR LIABILITY ON GUARANTEED WHEELS

THE sales contracts of most wheel manufacturers contain clauses whereby the wheel manufacturer guarantees the product against manufacturing defects either on a mileage or on a time basis. Under this guarantee, to a more or less extent, they are constantly being called upon to replace or reclaim wheels that have not given the normal or guaranteed amount of service, but only a few of them look upon the cost of replacement or adjustment as an item of operating expense. The most common practice is to consider the invoice price of the defective wheels returned, less the scrap value of the old wheels, as a sales deduction. In cases where this practice is followed, it is evident that the production cost of new wheels does not provide for or reflect the cost of replacing defective wheels.

The Blackburn Car and Foundry Company places either a mileage or a time guarantee upon all wheels leaving its plants. Starting in 1910, the company followed the practice of crediting into a reserve for liability against these guarantees, one-half of 1% of the total yearly sales. By 1920, this reserve had grown to such an amount that the company felt justified in discontinuing any further additions to that account. In the fall of 1920 a committee, appointed by the Association of Manufacturers of Chilled Car Wheels, of which the Blackburn Company was a member, prepared a uniform cost accounting system for car foundries which contained the following recommendation:

> Conservative accounting practice calls for the inclusion in the monthly cost statement of a provision covering the cost of reclaiming or replacing failed or returned wheels. It is recommended that provision

be made to take care of this added cost in the form of a reserve by a charge of a determined amount per ton of wheels manufactured. At the end of the year, should the provision made in this way be found to exceed the adjustment or the replacement cost, any excess balance of the reserve account can be transferred to Profit and Loss account or to Surplus account.

In the same report, the following appears under the classification of accounts:

Failed Wheels: To include a charge per-net-ton of wheels produced, based on past experience, sufficient to cover anticipated loss due to time or mileage guarantee of new wheels, credit an account "Wheel Reserve Guarantee." When defective wheels are returned for credit they should be charged into stock at the base market price, and there should be a charge to the "Wheel Reserve Guarantee" account equal to the difference between the credit allowed the customer and the scrap value of the returned wheels. When defective wheels are returned for replacement the cost of the new wheel, less scrap value of the old wheel returned, should be charged to the "Wheel Reserve Guarantee" account. If guarantee claims are settled on a cash payment basis, the payment is a direct charge to the "Wheel Reserve Guarantee" account.

The Blackburn Company has followed the general principle of accounting outlined in the above recommendation, but instead of transferring any surplus in the reserve account at the end of the year to Profit and Loss, it has allowed that surplus to accumulate from year to year. If the reserve account is to be left undistributed, and no further additions are to be made until it should be reduced to a normal size, present and future operations would be receiving a benefit at the expense of past years. The auditor therefore recommended that, in accordance with the system outlined by the Association's committee, the existing reserve be transferred to surplus account, and that in the future a yearly reserve should be set aside to cover the liability; that ordinary replacements should be charged to this yearly reserve; and that in the case of any unforeseen exceptional liability, a charge should be made direct to surplus.

Should the Blackburn Company have accepted the recommendation of its auditor?

27. TOBIN MANUFACTURING COMPANY—VALUATION OF FLOOR SPACE

The plant of the Tobin Manufacturing Company consisted of more than 30 buildings, varying in construction from one-story sheds to a six-story factory building of steel frame and cement construction, completed in 1917. The company manufactured brass and copper articles, and in common with other firms in the industry, expanded tremendously during the war, with the result that under the decreased demands of the post-war period the entire plant was not required. Several of the older buildings were abandoned, and the fabricating work concentrated in the newer buildings. Many departments were using well-lighted and airy rooms for storage and other purposes for which dark rooms of much less expensive construction would be entirely adequate.

Under the new conditions, a rent charge against the departments on a floor-space valuation, equal to that applied when these rooms were used for productive purposes, would penalize the departments using them for storage purposes. In the opinion of the work's accountant, suitability of a space for the purpose for which it was used should enter into the determination of the rental to be charged against the department. According to the comptroller suitability should not be considered, but a stated rental should be charged for a given floor space regardless of the use to which it was put. Under this method a department using inferior space would receive some benefit in the form of lower rent but the department using better quarters than necessary would be penalized.

How should the charge for rent of storage rooms have been handled on the books of the Tobin Manufacturing Company?

28. TOBIN MANUFACTURING COMPANY—THE TAX ON INVENTORY IN PROCESS

In several states a tax is levied on goods in process as shown by the physical inventory taken at the end of the fiscal year. The Tobin Manufacturing Company had shown this tax in its financial statements under "Other Charges" grouped with such items as interest. The tax had not been incorporated in the factory cost in any way.

It was suggested that, as the tax apparently would be levied for several years, it should be considered as a cost and charged against product through the operating department overhead. It should be allocated, therefore, to departments in the proportion which their respective inventories of goods in process bore to one another at the end of the financial year. This method was criticized by members of the accounting staff as unfair, since congestion of goods in process in a department on the day inventory was taken would penalize that department for a condition beyond its control. If any adjustment of such irregularities should be attempted, the distribution might as well be made on an arbitrary basis which would approximate the normal amount of goods in process in a department. Seasonal variations in manufacturing activities also might result in an unfair distribution of the tax, since the inventory in departments normally active might be extremely small at inventory time. Under this method, departments operating in the preliminary stages of the manufacturing process would be taxed on inventory of lower value than departments operating in the more advanced stages of the product, although this factor would be entirely beyond the control of the various departments. The opponents of the valuation method proposed that the tax should be apportioned on a physical basis, which would be determined by considering the average amount of goods in process in the entire plant, distributed to the operative departments in proportion to the average length of time consumed in the department by the process performed. This suggestion was based on the theory that the size of inventory of goods in process in a productive department was directly related to the amount of time required for the process there performed.

If the proposal to load the tax on the factory departments was carried to its logical conclusion, the finished stock department and the storage department would receive heavy additions to their overhead, because of large inventories. The accountants objected to this addition since it would tend to obscure the operating costs of these important departments; at the same time it was stated that taxes were an actual expense of carrying supplies of raw materials and stock, and accordingly should appear in a statement of the cost of stores departments. To avoid this difficulty, it was proposed that all taxes on stocks of raw materials,

supplies, and finished goods should be charged into general overhead to be distributed to productive departments on a basis of their work in process tax.

What method should the Tobin Manufacturing Company have used in distributing its charge for taxes on inventory?

29. THE BYFIELD COAL COMPANY—MAINTENANCE CHARGES

The Byfield Coal Company, in common with many other coal mining concerns, has been in the habit of charging to operating costs all those expenditures which were incurred for the acquisition of the new items of equipment, if such additions were intended only for the purpose of maintaining the previous rate of production. Thus, when the mine had been getting out 500 tons per day, and on account of geological conditions it appeared likely that this output could no longer be maintained without the addition of one or two new cutting machines, the laying of new trackage, and the opening of new passages, the costs of this development work have been charged to current operating expenses.

The Federal Trade Commission during 1917, 1918, and 1919 conducted investigations as to the costs of mining coal, and the form of inquiry used by the commission prescribed that expenditures of the kind referred to should be charged to capital account, and not to current operating expenses. The Commission contended that this was in accord with general accounting practice, which charges additions to equipment to capital account if those additions will be of service during more than one fiscal year. Hearings upon this difference of opinion were held before the Committee on Manufactures of the United States Senate,[1] at which the Commission brought evidence to show that the practice that they recommended was in accord with good accounting practice, and also that there was no uniformity of practice among the coal operators prior to the issue of their form. The Byfield Coal Company, on the contrary, contended that the Commission's method was a distinct change from their own current practice, and that it would necessitate keeping their books in a different manner from that to which they had been accustomed.

[1] *Publication S-4828*, Government Printing Office, 1921.

How should expenditures for development be handled in the accounts of the Byfield Coal Company under the conditions described?[1]

[1] The issue here presented came to trial in the Supreme Court of the District of Columbia in *Maynard Coal Company* vs. *Federal Trade Commission*. The Court issued an injunction restraining the Commission from collecting information on the forms referred to, on the ground that they constituted too much interference with the internal management of the company's business. The above example of the Byfield Coal Company is intended to be argued from an accounting point of view, upon a basis of business policy, irrespective of any question of the legal authority of the Federal Trade Commission to require information from the coal companies on any particular basis.

The following quotation from the Report and Suggestions of Committee on Standard Systems of Accounting, of the National Coal Association, p. 9, illustrates their views on the subject:

"After a coal mine has been developed and equipped to its planned output capacity, charges to its Capital Account should cease, and thereafter there will be few if any permissible charges to that account.

"Usually after one-third or one-half the life of the mine has elapsed, and from time to time thereafter, additions to power plant and major items of equipment will be necessary, and the Cost thereof should be set up in appropriate Additions and Betterment Accounts; and for these will have to be established an additional and separate depreciation rate based on the remaining coal or life of the mine.

"At the end of each month, Operating Account should be charged, and Depreciation credited with an amount equivalent to the depreciation rate multiplied by the number of tons mined during the month. At the end of the year Depreciation should be charged with the year's accumulation, and the respective elements of the mine written off in proper proportions. If, however, the operator prefers to allow total Depreciation to stand as a credit on the ledger, it should, in the Balance Sheet, be exhibited as a deduction from the cost of property. Irrespective of which way it is handled on the General Ledger, the proper reducing entries should be made against each element of the property in the Plant Ledger.

"The drawing of distinctions between capital and operating expenditures, in the accounting involved in permanent enterprises, is a favorite field for discussion among accountants, but in the case of coal mining or other wasting enterprises, experience teaches that the field for discussion, if indeed there be any, is extremely limited.

"After a coal mine has been developed and equipped to its contemplated or possible capacity, it is a constant consumer of material and supplies and equipment, which, though nominally of a durable nature, are subject to destructive wear and tear, by reason of the uses to which they are put, and all these appliances must be kept in repair to do their work or the output cannot be maintained.

"Mules and pit cars are constantly worn out, and have to be replaced, and as the working faces advance with the exhaustion of the coal, the length of haul, and consequent time of circulation of pit cars between the working face and dump increases, more motors, mules, and pit cars have to be supplied to maintain the output, and the more motors, mules, and pit cars in the mine, the greater expense for replacements and repairs.

"Also, with the advance of workings, more rails have to be laid and more copper wire or other conductors put up to carry power to the working faces to maintain the output. They remain in place until the mine is exhausted, and when they are recovered have but little net scrap value. In fact, any net salvage is relatively very small.

"The fact that these expenses are continually recurrent and practically a fixed

30. WINNISQUAM MILLS—INDIRECT LABOR

The departmental cost system of the Winnisquam Mills provides for the addition of a percentage for indirect labor to direct-labor charges in determining costs. Overhead is added as a percentage to the total labor charges. This treatment of indirect labor differs from that employed by many mills. Some systems combine indirect labor and burden into a lump sum which is distributed to the manufacturing departments on the basis of direct labor. Others apply indirect labor and overhead combined to the cloth on a pound basis. In a majority of instances the systems are not regarded as exact, but as approximations sufficiently accurate to help in the fixing of prices. Because the manufacturing processes in textile mills are continuous, and since the operations do not change, there is a uniformity in the material used, the labor expended, and the product resulting, that permits the use of standard percentages for distributing burden.

Processing in the Winnisquam Mills is divided into five departments. In the picking and carding department cotton bales are broken up and the cotton cleaned and drawn out into a thick fluffy cord called rovings. All the material finally goes to roving frames. The deliveries from these frames are in hanks (840 yards) of various weights which are paid for on a piece-rate basis. This can be reduced to a cents-per-pound cost. To this is added 80.01% for indirect labor.[1] To the total of indirect- and direct-labor charges is added 84.88% for overhead charges apportioned to the department. The indirect-labor charges in this department consist of the wages of the overseer, second hand, third hand, and clerk; of scrubbers, sweepers, oilers, waste handlers, elevator operator, and doffers; the handlers of the cotton in the opening room, and the operatives of the bale breakers;

factor in the cost of production per ton from year to year, proves that they constitute an operating rather than a capitalizable expense.

"This being so, it makes no difference to taxable income whether they are charged immediately to operating expense, or written off by deductions representing depreciation allowance which would have to be readjusted and compounded from year to year. As a practical matter, it is better to dispose of such expense by direct charge to operating expense rather than taken care of by vexatious refinements of accounting, that would be necessary if these items be capitalized and 'depreciated.'"

[1] These percentages and figures are for a representative three months' period.

the foreman and tenders in the picking room, and the grinders, tenders, and can men in the card room.

In the spinning department the rovings received from the picking and carding department are drawn out and twisted into fine thread or yarn on the spinning frames. The product of each frame is measured, and operatives are paid on the basis of the number of frames tended. This permits the securing of the direct-labor cost per pound. To this direct-labor cost is added 40.94% for spinning warp yarn and 35.88% for spinning filling yarn. To the total labor cost resulting is added 95.75% for both warp and filling spinning overhead. The indirect labor consists of the oversight and room help. An overseer, two second hands, two third hands, and a clerk are employed. The room help consists of scrubbers, sweepers, a shaft man, oilers, a waste man, an elevator operator, two roving men, two band boys, a spindle setter, and learners.

In the spooling and warping department the bobbins of warp yarn received from the spinning department are combined in one continuous length and wound on large spools. Since operatives are paid a piece-rate, based on the number of bobbins spooled, the direct-labor cost per pound can be computed. To this is added 24.92% for indirect labor in the department, and to the total labor charges 36.47% is added for the department overhead. Warping, which is performed in the same department, consists of winding the warp yarn from several small spools on large steel cores or beams. The direct-labor charges for removing the bobbins from frames are reduced to a pound basis, to which is added 108.91% for indirect labor, and to the total labor charges 36.47% is added for overhead charges. The indirect-labor charges are incurred for the overseer of the department, the second hand, and clerk; for the room help consisting of a yarn trucker, puncher and marker, bobbin boy, spool girls, sweeper, elevator operative, and warp man; and for the twisters who tie the yarn ends together.

Warp yarn is prepared for the weaving process by being passed through the slasher, which puts sizing into the threads to give them strength. The total labor in this department is combined because piece-rates are not used. To the labor cost per pound is added 64.51% for overhead.

In the weave room a piece-rate for weavers is determined for

Distribution of Overhead—First Quarter

	Group I	Group II	Group III	Group IV	Group V	Total	Mill Labor	Percentage of Department Overhead
Picking and Carding	$ 5,457.48	$18,107.16	$ 8,216.01	$ 4,802.55	$ 1,594.73	$ 38,177.93	(20.62) $ 44,976.20	84.88
Spinning	6,939.63	18,236.31	17,897.79	7,099.49	4,556.79	54,730.01	(26.22) 57,162.35	95.75
Spooling and Warping	1,889.74	2,460.35	617.16	443.38	269.02	5,679.65	(7.14) 15,571.65	36.47
Dressing and Drawing-in	950.16	1,362.56	1,220.00 385.73	801.11	343.67	5,063.23	(3.59) 7,848.15	64.51
Weaving	10,300.94	23,260.32	10,414.67	5,616.56	9,075.73	58,668.22	(38.92) 84,875.45	69.12
Cloth Room	928.99	1,149.45	1,041.47	603.35	194.10	3,917.36	(3.51) 7,656.40	51.16
Total	$26,466.94	$64,576.15	$39,792.83	$19,366.44	$16,034.04	$166,236.40	$218,090.20	76.22
Sizing Material					9,945.53	9,945.53		
Packing Material					2,883.69	2,883.69		
Total					$28,863.26	$179,065.62		
I. General Expense	$16,966.86							
Administration	9,500.08							
	$26,466.94							
II. Interest		$14,076.15						
Taxes		20,000.00						
Insurance		5,500.00						
Depreciation		25,000.00						
		$64,576.15						
III. Power			$39,792.83					
IV. Repairs				$19,366.44				
V. Supplies					$28,863.26			
		Overhead Charges		$ 179,065.62				
		Mill Labor		218,090.20				
		Cotton		594,118.06				
		Selling Expense		26,381.24				
				$1,017,655.12				

Bases of Distribution

Group
- I. Divided prop. to Payroll
- II. Divided prop. to value of space occupied and value of Mach. and Equip.
- III. Divided prop. to Power Used
- IV. Divided prop. to {Space occupied / Direct power
- V. Direct.

COST CARD

	Pounds per Week per Loom	Yards per Day per Loom	Pounds per Piece
Style Number X..... Class	.....	.....	.....

Width, 38½ in. Weight, 5.00 Yards per Pound. Weave....Looms per Weaver....

Cost, Cents per Pound

Remarks .....

Yarns	Sley 56 ÷ Warp 28 = 2.00	54.5% x 10.91c	Pound Cost of Yarns	= $ 5.95
	Picks 48 ÷ Fill 30 = 1.60	45.5% x 11.45c		= 5.21
	3.60	Total Cost of Yarns		11.16
Dressing and Drawing In Warp 54.5% x 2.20 Cents per Pound				= 1.20
Weaving Cut Price 24 Cents ÷ 60 Yards per Cut = .4 cents + 68.69% = .6748c				
.6748c + 69.12c = 1.1412 Cents per Yard x 5.00 Weight				= 5.71
Cloth Room and Packing Per Yard .189 Cents x 5.00 Weight				= .95
Total Manufacturing Cost				19.02
Selling Expense 3% of 50 Cents per Pound Estimated Selling Price				= 1.50
Total Cost without Cotton				20.52
Price Cotton 22 Cents ÷ 82% (18% Estimated Allowance for Waste)				26.83
				47.35

Date.....

each style of cloth; this can be reduced to a direct cost per pound for each style. The cost per pound for loom fixers is estimated on the basis of the number of looms looked after. To this is added 68.69% for indirect labor. To the total labor cost is added 69.12% for overhead. The indirect labor consists of oversight and room help. An overseer, two hands, and a clerk, are employed to direct operations. The room help consists of two elevator men, a shaft man, scrubbers, sweepers, blowers, cleaners, oilers, smash fixers, warp men, bobbin cleaners, and filling men.

The woven cloth is sent to the cloth room where it is inspected, measured, and baled preparatory to shipment. The total payroll in this department is divided by the number of pounds handled to give the labor charges per pound. To this is added 51.16% for overhead charges.

The percentages of indirect to direct labor and of overhead to total labor to vary from quarter to quarter, but in quoting

prices standard figures are used which are regarded as normal. The overhead for one quarter is distributed and percentages computed on the report shown on page 326.

The procedure in quoting a price on a style of cloth is as follows: The costs of manufacturing in the five departments are added. To this amount a selling expense of 3% of the estimated selling price is added. Raw material cost is figured at the price paid for cotton, based on the weight of the cloth with an allowance for waste. The total of departmental costs, selling expense, and raw material is the cost of the style of cloth. An example of the typical cost card is shown on page 327.

The application of indirect labor to direct labor is regarded as equitable, because superintendence and indirect labor are expended upon direct laborers in proportion to their earnings. The distribution of overhead on the basis of total labor charges also is regarded as fair, because the most important items of executive salaries, power, and fixed charges are incurred approximately in proportion to direct labor expenditures within a department. The fact that indirect labor can be allocated directly to the manufacturing departments, and that the various items of overhead can be distributed to them on equitable bases, makes possible the division of costs into direct and indirect labor and overhead by departments. If the allocation to departments of overhead and indirect labor were not made, it is probable that this division into indirect and direct labor would not be practicable. In one mill, for example, indirect labor and overhead were combined into a lump sum and distributed to the departments on the basis of direct labor. A subsequent investigation showed that the proportion of overhead to direct labor in the various departments varied from 24% to 172%.

REFERENCES

A. DEPRECIATION AND DEPLETION

ARMSTRONG, GEORGE S. *Essentials of Industrial Costing*, Chapter VIII.

BERRY, S. "Depreciation of Physical Property Used in Timber Industry," *American Lumberman*, Oct. 9, 1920, pp. 76-77.

CAIRNS, WILLIAM. "Depreciation and Depletion in Tax Returns," *Journal of Accountancy*, Sept., 1919, pp. 204-211.

DICKINSON, ARTHUR LOWES. *Accounting Practice and Procedure*, pp. 44-45, 167-174.

DICKSEE, L. R. *Comparative Depreciation Tables*, Second Edition, Gee & Co., London, England, 1909.

DuBrul, E. F. "Necessity of Reserving against Obsolescence and Inadequacy," *Administration,* June, 1922, pp. 669-671.
Farrell, M. G. and Heywood, J. "A Sound Way to Charge Depreciation," *System,* Aug., 1922, pp. 148-150.
Floy, Henry. *Value for Rate Making,* pp. 235-311. McGraw-Hill Book Co., New York, 1916.
Forster, H. A. *Engineering Valuation of Public Utilities and Factories,* pp. 147-218.
Garcke & Fells. *Factory Accounts—Their Principles and Practice,* Chapter VI.
Gower, William B. "Depreciation and Depletion in Relation to Invested Capital," *Journal of Accountancy,* Nov., 1919, pp. 353-368.
Jackson, J. Hugh. "Depreciation Policy and True Cost," *Journal of Accountancy,* June, 1920, pp. 452-455.
Leake, P. D. *Depreciation and Wasting Assets.* Isaac Pitman & Son, New York, 1917.
Leake, P. D. "Leake's Register of Industrial Plant," H. Good & Sons, London, England.
Manning, A. B. "Fixed Property Accounting," *Administration,* Dec., 1921, pp. 758-774; Jan., 1922, pp. 89-112.
May, George O. "Problem of Depreciation," *Journal of Accountancy,* Jan., 1915, pp. 1-13.
Montgomery, Robert H. *Income Tax Procedure,* The Ronald Press Co., New York, 1920.
Nash, L. R. "Depreciation Reserves as Affected by Property Growth," *American Economic Review,* Mar., 1916, pp. 69-89.
Nelson, Gilbert. "Depreciation and Depletion in Relation to Income Tax Returns," *Journal of Accountancy,* Feb., 1919, pp. 111-119.
Nicholson, J. Lee and Roorbach, John F. D. *Cost Accounting,* pp. 144-162, 529.
Saliers, Earl A. *Principles of Depreciation.*
Saliers, Earl A. "Production Method of Charging Depreciation," *Administration,* May, 1922, pp. 582-586.
Scharff, M. R. "Maintenance, Renewals, Replacements and Retirements," *American Gas Journal,* Dec. 16, 1922, pp. 669-671.
Staub, W. A. "Amortization Under the Income Tax Laws," *Administration,* Mar., 1923, pp. 309-319.
——— *Accountants' Index,* American Institute of Accountants. References on Depreciation, Depletion and Obsolescence, pp. 344-679.
——— *Depreciation, Amortization, Depletion,* Articles 161-237, Regulations 62, Relating to the Income Tax, and War Profits and Excess Profits Tax under the Revenue Act of 1921. Government Printing Office, 1922.
——— Pamphlet on *Depreciation.* Fabricated Production Department of the Chamber of Commerce of U. S.

B. SPOILAGE AND WASTE

Church, A. Hamilton. *Manufacturing Costs and Accounts,* Chapter IX.
Jordan, J. P. and Harris, Gould L. *Cost Accounting Principles and Practice,* Chapter XXVI.
Kilduff, F. C. "Spoilage, the Fourth Factor of Cost," *Journal of Accountancy,* Mar., 1917, pp. 191-195.
Knoeppel, C. E. "Measuring Waste in Industry," *Bulletin of the Taylor Society,* April, 1922, pp. 69-80.
Kokins, J. W. "The Scrap Problem," *N. A. C. A. Official Publications,* Vol. III, No. 11.
Loper, R. E. "Waste in Cotton Manufacturing," *Textile World,* Dec. 23, 1922, pp. 41, 43, 45.
Mitchell, T. W. "A Further Consideration of the Report of the Committee on Elimination of Waste in Industry," *Bulletin of the Taylor Society,* Oct., 1922, pp. 198-204.

NICHOLSON, J. L. "Scrap and Waste—Their Causes and Remedies," *Management Engineering*, Feb., 1923, p. 124.
WALLACE, L. W., et alii. "Cost Systems as a Means of Preventing Waste," *N. A. C. A. 1921 Year Book*, pp. 99-140.
WALTON, SEYMOUR. "Cost of Breakage and Leakage," *Journal of Accountancy*, Feb., 1915, pp. 149-152.
WILSON, GORDON. "Fourth Factor in Cost Accounting," *Journal of Accountancy*, May, 1917, pp. 321-325.
——— "Waste in a Woodworking Plant," *N. A. C. A. Bulletin, No. 5*, June 1, 1921, pp. 20-21.
——— "Waste in Industry," *Committee on Elimination of Waste in Industry of Federated American Engineering Societies*. McGraw-Hill Book Co., New York, 1921.

C. DEVELOPMENT COSTS

STAUB, WALTER F. "Deferred Charges to Operating," *Journal of Accountancy*, Oct., 1909, pp. 411-412.
——— "Cost of Developing New Model," *N. A. C. A. Bulletin No. 43*, Dec. 15, 1922, pp. 484-490.
——— "Standard Accounting and Cost System for the Electrical Manufacturing Industry," *Electrical Manufacturers' Council*, Fourth Edition, Oct. 1, 1922, sec. 1, pp. 1, 4; sec. 3, p. 18; sec. 4, p. 13.

D. INTEREST AS A COST

BERNDT, IRVING A. *Costs*, pp. 90-100.
CASTENHOLZ, WILLIAM B. "Is Interest on Invested Capital a Cost?" *Journal of Accountancy*, April, 1918, pp. 248-254.
CHURCH, A. HAMILTON. *Factory Costs and Accounts*, pp. 392-394.
COLE, WILLIAM MORSE. *Journal of Accountancy*, April, 1913, pp. 232-236, 342-346
DICKINSON, A. L. *Accounting Practice and Procedure*, pp. 200-208.
ESQUERRE, PAUL JOSEPH. *Applied Theory of Accounts*, pp. 439-440.
GAUSE, EDMUND C. "Relation Between Interest and Manufacturing Costs," *Journal of Accountancy*, Mar., 1918, pp. 187-190.
HOWARD, STANLEY E. "Interest, Rent and Normal Return on Capital Investment in their Relation to Manufacturing Costs," *American Economic Review*, Sept., 1920, pp. 546-562.
JORDAN, JOHN P. and HARRIS, GOULD L. *Cost Accounting*, pp. 428-443.
KESTER, ROY B. *Accounting Theory and Practice*, Vol. II, pp. 468-472.
LEAKE, P. D. *Depreciation and Wasting Assets*, pp. 33-52.
MAY, GEORGE O. "Reasons for Excluding Interest from Cost," *Journal of Accountancy*, June, 1916, pp. 401-409.
MONTGOMERY, ROBERT H. *Auditing Theory and Practice*, 1922 Edition, Vol I, pp. 155-158.
NICHOLSON, J. LEE and ROHRBACH, J. F. D. *Cost Accounting*, pp. 138-140.
SCOVELL, CLINTON H. et alii. *Papers and Proceedings*, American Association of University Instructors in Accounting, Jan., 1919, pp. 12-40.
SCOVELL, CLINTON H. *Cost Accounting and Burden Application*, Chapter VII.
SCOVELL, CLINTON H. and STAUB, E. E., et alii. "Interest as an Element of Cost," *N. A. C. A. 1921 Year Book*, pp. 47-96.
STERRETT, J. E. "Interest Not a Part of the Cost of Production," *Journal of Accountancy*, April, 1913, pp. 241-244.
WALTON, SEYMOUR. "Interest as an Element of Cost," *Journal of Accountancy*, Oct., 1919, p. 311.

E. POWER COSTS

ARMSTRONG, GEORGE S. *Essentials of Industrial Costing*, pp. 184-202.
ALWYN-SCHMIDT, L. W. "Economics of the Power House," *Power Plant Engineering*, Dec. 1, 1918, pp. 942-952.
BANCROFT, B. M. "Apportioning the Cost of Power," *Paper*, Oct. 16, 1918, pp. 13-14.
EDWARDS, H. M. "An Accounts System for Industrial Coal," *The Black Diamond*, Oct. 8, 1921, pp. 337-339.
EDWARDS, H. M. *Electric Light Accounts and Their Significance*. McGraw-Hill Book Co., New York, 1914.
FENNER, T. H. "Simple Method of Determining Power Costs," *Power House*, Dec., 1918, pp. 361-363.
FICKER, N. T. "Distributing Overhead Expense," *Engineering Magazine*, Sept., 1915, pp. 862-871.
GOULD, GERALD B. and HUBBARD, CARLETON W. *The Cost of Power*, pp. 13-21, 105-120. Fuel Engineering Co., New York, 1914.
HERMANN, C. C. "Power Plant Performance and Cost Record," *Industrial Management*, May, 1922, pp. 313-317.
HILL, R. P. "Heat, Light and Power Problems; Principles of Accounting and Control of Industrial Power Plant Costs," *Paper*, April 9, 1919, pp. 15-18.
HUNTINGTON, A. E. "Power Plant Cost Sheet," *Power*, July 15, 1919, pp. 120-121.
JONES, EDWARD D. *Administration of Industrial Enterprises*, Chapter VI.
KENT, WILLIAM. *Bookkeeping and Cost Accounting for Factories*, pp. 208-212.
MILLER, W. A. "Distributing Power Charges," *Power Plant Engineering*, Mar. 1, 1922, pp. 255-259.
MYERS, D. M. "Cost Cutting for Industrial Power Plants," *Industrial Management*. A series of articles running from Mar., 1922, through July, 1922.
POLAKOV, W. N. "Mastering Power Production, Principle of Essential Cost and Use of Standard Cost," *Industrial Management*, Oct., 1918, pp. 321-329.
SCOVELL, CLINTON H. *Cost Accounting and Burden Application*, Chapter X.
SOPER, H. B. "Standardization of Power Plant Operating Costs," *Power*, Mar 14, 1916, pp. 375-376.
WOLFE, FRANK B. "Distribution of Operating Costs of Centralized Power Plants at Low Capacity," *N. A. C. A. Official Publications*, Vol. III, No. 16.
——— "By Measurement of Current Used and Extended Records Large Savings Can Be Made in Power Cost," *Coal Age*, Sept. 28, 1922, pp. 494-496.
——— "Power Costs," *N. A. C. A. Bulletin No. 19*, January 15, 1922, pp. 120-122.
——— *Power*. Articles throughout 1921 issues on cost accounting for power plants.

F. RETURNABLE CONTAINERS

CHRISTIE, W. P. "Eliminating Cement Sack Losses," *The Contract Record and Engineering Review*, June 7, 1922, pp. 542-543.
JACKSON, J. HUGH. "Bottlers' Accounts: Accounting for Containers." *The Beverage Journal*, February 15, 1921, pp. 55-58.
LINDARL, O. N. "Accounting for Returnable Cloth Sacks in Cement Industry," *N. A. C. A. Bulletin No. 37*, Oct. 1, 1922, p. 400.
O'NEILL, C. J. "Keeping Account of Empty Packers," *The Ice Cream Trade Journal*, May, 1921, pp. 51-52.
LANHAM, H. *Brewers' and Bottlers' Accounts*. Gee & Co., London, England, 1916.
LYMAN, G. V. W. "Treatment of the Returnable Package in Accounts," *Journal of Accountancy*, June, 1914, pp. 427-430.
MEINHARDT, HAROLD S. "Accounting for a Portland Cement Mill," *Journal of Accountancy*, Sept., 1922, pp. 196-197.
WALL, RAYMOND J. *National Bottler's Gazette*, Nov. 5, 1920, pp. 98-101.
WALTON, SEYMOUR. "Depreciation on Circulating Containers," *Journal of Accountancy*, Aug., 1918, p. 150.

G. MISCELLANEOUS EXPENSES

ALWYN-SCHMIDT, L. W. "Equipment and Maintenance Factors in Cost Accounting during Transition Period," *American Machinist*, Feb. 20, 1917, pp. 366-388.
BROWN, CHARLES S. "Importance of Inventories in Figuring Excess Profits Tax and Fire Insurance," *Inland Printer*, Mar., 1919, pp. 681-682.
COLE, WILLIAM MORSE. *Accounts—Their Construction and Interpretation*, Chapter VII.
DICKINSON, A. LOWES. *Accounting Practice and Procedure*, p. 108.
DOWLER, FRANK and HARRIS, E. M. *Auditing, Accounting and Banking*, pp. 138-151.
FINNEY, H. A. "Inventory Reserves," *Journal of Accountancy*, Dec., 1920, pp. 462-464.
HATFIELD, HENRY RAND. *Modern Accounting*, pp. 233-273.
MCLAREN, N. L. "Inventories and Their Income Tax Procedure," *Journal of Electricity*, Jan. 1, 1920, pp. 6-7.
MONTGOMERY, ROBERT H. *Income Tax Procedure*, 1920, pp. 295-308.
NICHOLSON, J. LEE and ROHRBACH, JOHN F. D. *Cost Accounting*, pp. 136, 161-162, 192-193, 270-272.
——— "Excess Profits Duty: Official Statement," *Accountant*, July 21, 1917, pp. 50-53.

VI

COST SYSTEMS FOR REPRESENTATIVE INDUSTRIES

A. MINING AND LUMBERING

1. THE BLUE GOOSE COAL COMPANY—COAL MINING COSTS [1]

THE management of the Blue Goose Coal Company is dissatisfied with the system of ledger accounts now in use in determining costs at its bituminous mine in eastern Ohio. It has decided that the old ledger accounts will be discarded, but that the forms on which payroll and other costs are reported to the office will be retained. With these forms as a basis, the Blue Goose Company will install a new ledger system which will be as simple as possible, and at the same time represent accurately the financial condition of the company and its costs of operation. These forms are used in reporting the costs of the following operations:

Electric cutting machines, operated by two men called "machine men," make a 6-inch or 8-inch cut under the seam of coal, the width of the room or entry, and about 6 feet in. The "loaders," two working in each room or entry, drill three holes in the coal near the "roof" and "shoot down" the coal. The coal is then loaded by hand or shovel into small mine cars which hold from two to three tons. Ordinarily two machine men can do the cutting for 18 or 20 loaders. In wide work "one cut" will bring down about three tons of coal. These cutters and loaders are paid on a tonnage-loaded basis.

In addition to loading the coal shot down, the "loaders" take down any dangerous roof, and timber their rooms or entry. The handling of this roof material which has to come down, is done by the "loaders" up to a certain number of inches in width without additional compensation. Over this width they receive

[1] *See:* National Coal Association, *Report and Suggestions of Committee on Standard System of Accounting;* National Association of Cost Accountants, Vol. II, No. 17. *Coal Production Costs;* Reed, *Bituminous Coal Mine Accounting.*

compensation on a "yardage" basis for all slate and rock handled. Yardage is also paid if rooms and entries are deficient in height, and when such things as "horse-backs" or clay veins are encountered. In the rooms this slate and rock, which is known as "gob," is disposed of by throwing it back on either side of the track. In the entries there is no room for this and the gob must be loaded into cars and disposed of on the outside. Work done on a yardage basis is usually spoken of around the mine as "deadwork."

Motormen, snappers (brakemen), wiremen, electrical repairmen, trappers, brattice men, fire bosses, track layers, and water haulers are paid on a day scale. Superintendents, mine foremen, assistant mine foremen, the weigh boss, outside boss, teamsters, bookkeepers, blacksmiths, and machinists are ordinarily paid on a monthly basis.

The cars, when loaded in the individual rooms, are gathered either by small motors running into the room on tracks, or by a crab motor in the main passageway equipped with a roll of wire cable with which to drag the cars out onto the main track. The loaded cars are made into trains of approximately 50 cars each, and are hauled out into the open by a larger motor. This is a "drift" mine, and, consequently, it is not necessary to hoist the coal to the surface. The seam of coal is several hundred feet above railroad level on the side of the mountain. When the cars reach the outside an endless wire rope lowers them 170 feet down a 33% grade into the tipple over the railroad tracks. Attached to one of the sheave wheels, upon which this rope runs, is a motor generator which acts as a brake after the rope is loaded, and at the same time furnishes a small amount of power. The loaded cars going down exert much more force than is required to haul the empties back. At the tipple the coal is dumped out of the mine cars, cleaned, weighed and sorted by screening into four grades—lump, egg, nut, and slack—and loaded into railroad cars for shipment.

The capital equipment consists roughly of a tipple costing $50,000, fans $35,000, several 5-ton motors at $5,200, two 10-ton motors, cutting machines averaging $2,600 each, machine and repair shops, rails, cars, and office equipment, which brings the total cost of equipment to about $300,000. When a new

mine is opened, it is the practice of this company to depreciate immediately by 10% all the equipment which is purchased, and the resulting charge is spread over the next 18 months. (The buildings and shop are depreciated on a different basis.) This charge has been found to correspond closely with normal operating maintenance cost, which ordinarily does not arise during the first 18 months. At the end of that time, however, some new cars and rails must be obtained, as well as repair parts for cutting machines and motors. These replacements for maintenance, which are kept up at nearly constant rate during the life of the mine, maintain the equipment in good working order indefinitely. Sand, oil, rail, wire, and supplies of posts to support the roof, which are necessary for daily operation, are bought by the carload and are put directly into the mine.

The 10,000 acres owned by the company are appraised at $500 per acre. At present, an output of about 7,500 tons per acre is obtainable, but geological conditions make it unsafe to count on an average for the whole tract of over 5,000 tons per acre. Daily output of the mine is about 1,500 tons mine-run. The electric power is purchased, except the small amount furnished by the generator on the rope.

The operating expense may be divided as follows:

Direct Labor	65%	Materials	5%
Indirect Labor	20%	General Expense	10%

There are no accepted standards for efficiency in the mine. The work of the gatherers is governed entirely by transportation and the number of loaders available. There is a check made on gathering for each district in the mine. The original records are the time books kept by the foreman on his daily trip through the mine, and the weigh sheets handled by the weigher at the tipple.

There is a constant overhead expense of the wages paid to "company men" (men paid on a monthly basis). Variations in piece-rates are made according to the thickness of the vein of coal or other unusual operating conditions, such as water in the mines. When the coal is sold, an average selling price per run of mine-ton is obtained by averaging the prices of the four grades weighted by the amount of each grade sold.

The following forms are used by the company:

Weigh sheet
Time sheet
Deadwork sheet
Payroll sheet
Payroll recapitulation
Pay statement
Card for recapitulation of each individual's annual earnings, for use in connection with income tax information returns
Tipple car sheet
Invoice transmittal record sheet

From the weigh sheet are obtained the credits to the individual miners for loading coal, and from the time sheet, the day men's credits for day labor. From the deadwork sheet are obtained the sundry other credits to the men on account of the special conditions in which they are working. All this information is posted in proper columns and to the proper account (or line) on the payroll sheet.

The labor classifications are kept separate to conform to the items appearing upon the payroll recapitulation. These classifications conform as far as possible to the standard form suggested by the Coal Association.[1] Every half-month, vouchers are made up for each mine from the payroll recapitulation, covering the debits to operating expense, and the credits for deductions for store and rents. The balance required for the cash payment is carried over as a credit to the account of vouchers payable, which is cleared by the usual voucher check when the payroll is drawn. The journal voucher is used for all entries which do not involve the payment of cash, such as royalty

[1] The Report of Committee on Standard System of Accounting, National Coal Association, p. 2, reads as follows:

Before discussing the details of an accounting system, it is useful to emphasize the fundamental truth that every coal mine consists of: owned or leased coal deposits, plant, equipment, and development.

In the case of some mines, the greater cost will be the coal; in another the equipment; and the cost of development will be more or less, according to the physical conditions of each operation, but all these elements make a coal mine, and when the operating stage is reached their combined value as a mine is greater than the sum of their separate costs.

They all depreciate together as the coal is exhausted, for when the coal is gone, or the right to the coal has elapsed, the plant and equipment have little or no value and the development is lost.

Capital investment in a coal mine is not a permanent asset; it is only an outlay preliminary to the extraction of the coal; it is merely an advanced or deferred

Sheet 2

For Name of Company

Report of Cost, Income and Tonnage

For Month of _____

COST

Line No.	ACCOUNT	CURRENT MONTH				YEAR TO DATE	
		LABOR	SUPPLIES	TOTAL		TOTAL	
		Amount	Amount	Amount	Per Ton	Amount	Per Ton
33	General Expense.....						
34	Officers' Salaries and Expenses..						
35	Other Salaries.....						
36	Rent and Miscellaneous Office Expense						
37	Legal Expense.....						
38	.....						
39	.....						
40	.....						
41	Total General Expense.....						
42	Total Operating and General Expense (add lines 32 and 41)						
43	Selling Expense.....						
44	Officers' Salaries and Expenses..						
45	Salesmen's Salaries and Expenses						
46	Other Office Salaries.....						
47	Rent and Other Office Expense..						
48	Advertising						
49	Commissions						
50	Miscellaneous.....						
51	.....						
52	.....						
53							
54	Total Selling Expense.....						
55	Total Operating, General and Selling Expense (add 42 & 53)						
	.....						
	.....						
	.....						

Form 34: Continuation of Form 2 on page 12

accruals, depreciation, and similar transfer or adjustment items. Invoices for supplies for the mines are approved at the mine. office, where they are recorded as direct charges to the operating expense account.

A form of cost sheet is shown on pages 12 and 337.

Draft rulings for a set of forms suitable for the labor records of the Blue Goose Coal Company.

What ledger accounts should be kept?

What should be the basis and method of computing (a) depreciation on mine equipment, (b) depletion on the mine deposits?

In a mine where the most easily accessible coal was taken out first, and the more remote sections of the mine were uncertain, what should be the basis of depletion?

2. SPRINGVALE COPPER MINING COMPANY— COST ACCOUNTING SYSTEM

The Springvale Copper Mining Company owns, in southern Utah, three deposits of the hill type.[1] Since the mines are far re-

charge upon future income, which capital, if recovered, must be recovered with the current expenses of operation out of the proceeds of coal sold.

By dividing the cost of the mine by the total number of tons practically recoverable through present shafts and openings, the rate per ton necessary to redeem such cost will be found.

In coal mining the exact unit for the measurement of work done is the ton of coal mined. It is also the exact unit for measuring depletion of mineral, wear and tear from use of equipment, and exhaustion of development. Development is a mere easement, the value of which disappears when the coal is gone.

A coal mine being, as emphasized, made up of several elements, all depreciating as the coal is mined, such depreciation is composite, accruing at a rate concurrent with the rate of extraction. The necessary rate per ton being determined, the aggregate depreciation for any accounting period should, of course, as far as practical, be distributed among the various elements in proportion to their respective costs or value.

The doctrine that measures depreciation of coal mine plant and equipment in terms of time (excepting, of course, some leasehold propositions) is fallacious, as tested by the further assertion that a completely equipped mine could be maintained indefinitely, without depletion or wear and tear if no coal were mined, by minor repairs.

Therefore, we insist, as a general rule—excepting some leaseholds—that the correct measure of the depletion and depreciation experienced in mining coal is the ton of coal mined.

[1] In the states of Utah, Colorado, Idaho, and Arizona, there are large ore deposits containing small amounts of copper distributed through the mixture. In some cases the deposits are elevated by volcanic action and form hills. Mining of this type of ore is accomplished, therefore, by digging away the side of the hill, or by excavating a pit in the ground by the use of steam shovels.

These porphyry ores are considered low-grade because their copper content is

moved from communities, the company must maintain complete villages for the miners; this involves carrying large inventories of supplies and repair parts, and conducting all those operations which are ordinarily done by store-keepers.

Cost Accounting System at Mine A

Mine A is operated on eight levels, each of which is treated as a department, for which a monthly per-ton cost of mined ore is obtained. All labor is on a day-rate and is charged directly to the level where used. Indirect labor, which is required for shifting temporary tracks and similar tasks, is charged as far as possible to the level where used. Indirect labor of a general nature is distributed with overhead expense. Supplies and explosives are charged to the department where used. General overhead is allocated to the various departments in proportion to the tons produced during the month. Thus, all expenses are charged to the levels as departments. This arrangement proves satisfactory where only one steam shovel operates on a level. In case two or more shovels are operating on the same level, an attempt is made to allocate expenses to each steam shovel; thus a check on the comparative operating efficiency of each shovel and its crew is obtained. Departments are credited with production from day to day at the average cost for the preceding month, determined by dividing the total departmental expense by the tons produced. Any difference between this cost and actual cost is carried in an adjustment account. This practice has been opposed by the works accountant who wishes to make only one credit entry for production at the end of the month. The works manager defends the present method on the ground that

small, usually not more than 1% to 2%, but since the metal is evenly distributed through the mass, the available ore and approximate cost of handling and extracting the copper can be rather definitely determined in advance of actual commercial operations by means of prospecting.

Porphyry mines, whether in the form of a hill or surface deposit, are usually covered by a layer of several feet of surface matter which must be removed before operations can be commenced. This process is known as stripping. The mine is usually worked on several levels at the same time; thus a hill-side or pit-side is given the appearance of a pyramid. Standard gage railway tracks are laid on each level in order to permit the ore to be loaded by steam shovels into cars, which can be switched to the main line and hauled directly to the smelter without transferring the ore. The deposits are usually hard and blasting is required. Charges are set off simultaneously on all the levels. Blasting is done one, two, or three times a day, depending upon the activity of the mine. The maintenance and shifting of temporary tracks laid on the levels is considered a direct part of the mining cost. The company's own engines operate from the main line to the levels.

changes in the cost of mining a ton of ore are emphasized by the adjustment entries.

Depreciation and depletion are not included in the departmental costs, but are added as an arbitrary charge after all other costs have been determined. The management justifies this method by the argument that it is particularly interested in the operating efficiency of the mine, which would be distorted were depreciation and depletion included in operating costs. It emphasizes the fact that these two items cannot be determined with sufficient accuracy to warrant their being included in operation cost, and, having once been calculated, will not vary with operating efficiency.

Stripping. Since stripping as a whole is considered as a department, stripping costs are collected in practically the same detail as mining costs. It is comparatively easy to gather charges for stripping, but when an attempt is made to apportion these charges to the product, difficulties are encountered; the surface covering varies in thickness and the amount of metal made available by stripping varies greatly, although this variation can be determined with considerable accuracy beforehand. Whether to group all stripping charges and write off proportions monthly, or whether to allocate stripping costs to a given area and load that cost on the ore uncovered, is a constant source of discussion among the porphyry mining accountants. At present the Springvale Company makes an arbitrary per-ton charge to the product for stripping. This charge has been developed by a study of stripping costs over a period of years as related to the ore production of the company over the same period.

Supporters of the system of allocating stripping costs to the metal uncovered claim a greater refinement of cost. The accountants of the Springvale Company admit this assertion, but do not use the method because of the added cost entailed in keeping more detailed records. They maintain, furthermore, that such refinement of one item of cost is out of place in a system which is based on monthly average costs for the majority of items.

Valuation of inventory is another constant source of discussion. One of the more common practices is to value the inventory

at a standard rate, and absorb any difference between standard and actual selling price in an inventory adjustment account. Another method is to value inventories at the market price at the end of each month. This method has the advantage of being more definite, but has the disadvantage of making the inventory figures non-comparable. The Springvale Company values its inventory of ore as follows:

1. Actual sales carried at selling price. (Most sales are made for 60-90 days delivery.)
2. Ore in the hands of the selling company or in process of smelting and refining valued at standard rate. (Smelting and refining is done by an outside company at a set rate per pound.)

Inventories of supplies are carried at actual cost and charged out of stores at the actual price plus transportation. Inasmuch as supplies are purchased in large quantities, the various lots can be kept separate with comparative ease. Expenses are entered in the cost books from the primary records, and the monthly statements are drawn from the cost ledger after all interdepartmental and distribution entries have been run through the journal and posted. This method, which has the advantage of showing a current record of each account at all times, is employed because it involves no more labor than the collection of costs from primary records on a monthly statement and the posting on the cost ledger.

Operating expenses are computed monthly on a basis of both dry tons of ore and pounds of fine copper content, as determined by an assay of ore made daily. Gold, silver, and other precious metals are credited to the mine at standard rates established yearly. These are not deducted, however, from the operating figures, but are shown in the profit and loss statement of operations. The following monthly statements are compiled by the Springvale Copper Mining Company:

COPPER MINE—MONTHLY STATEMENTS

Supplies

Item	Stock Balance First of Month	Received	Issued	Stock Balance End of Month
Hardware				
Coal				
Electric Power and Light				
Explosives				
Oil, Water and Packing				
Repairs and Renewals to Equipment				
Miscellaneous				

DETAIL OF OPERATING EXPENSES

Mining

Item	Labor	Supplies	Total
Plant Administration			
Mine Office			
Mine Warehouse			
Engineering—General			
Heating Plant			
Safety First			
Welfare Expense			
Total			
Other Mine Charges			
General Supervision			
Assaying			
Handling Material			
Precipitation Plant			
Searchlight			
Prospecting			
Loss and Damage Expense			
Repairs to Buildings			
Assessment Work			
Yard Switching			
Watchmen, and so forth			
Total			
Drilling and Blasting			
"F" Level			
"G" Level, and so forth			
Total			

(Continued on following page)

Item	Labor	Supplies	Total
Steam Shovel Operations			
"F" Level, and so forth			
Locomotive Haulage (to main line only)			
"F" Level, and so forth			
Track Maintenance			
"F" Level, and so forth			
Dump Car Repairs			
"F" Level, and so forth			
Recapitulation			
Plant Administration			
Other Mine Charges			
Drilling and Blasting			
Steam Shovel Operations			
Locomotive Haulage and Track Maintenance			
Dump Car Repairs			
Total			

All these accounts are kept also for "stripping."

MONTHLY REPORT ON CAPITAL PROPERTY RETIRED

Date Constructed	Credit Property	Charge			Demolition Expense	Total Loss in Retirement
		Salvage	Depreciation	Loss on Retirement		

RECAPITULATION OF OPERATIONS

Item	Ore	Stripping	Other	Total
Supplies Issued				
Plant Administration				
Other Mine Charges				
Drill and Blast				
Steam Shovel Operation				
Locomotive Haulage				
Track Maintenance				
Dump Car Repair				
Additions and Betterments				
Total				

(Continued on following page)

Item	Ore	Stripping	Other	Total
Payroll				
Plant Administration				
Other Mine Charges				
Drill and Blast				
Steam Shovel Operation				
Locomotive Haulage				
Track Maintenance				
Dump Car Repair				
Additions and Betterments				

DETAIL OF OPERATING EXPENSE

(These figures obtained in total, per dry ton, and per pound)

Item	Total	Per Dry Ton (Ore)	Per lb. (Copper)
Dry Tons Ore Mined			
Net Pounds Copper			
Mining			
Plant Administration			
Other Mine Charges			
Drill and Blast			
Steam Shovel Operations			
Locomotive Haulage			
Administration Offices			
Legal			
Salaries			
Taxes			
Insurance			
Depreciation			
Retirement Loss			
Rent			
Indirect Expense			
Total Mining Expense:			

3. KINGFIELD PAPER COMPANY, LIMITED— SYSTEM OF LOGGING ACCOUNTS

The Kingfield Paper Company, Limited, has recently acquired large tracts of timber for its paper mill, but it has not yet decided upon the accounting system which will be used in the woods. It has drawn up a cost chart showing the different costs which enter into the wood in the piles at the mill. This

chart shows the various costs beginning with the stumpage. On the left-hand side, as shown in Form 35, are given the costs that enter into the landed cost when the operation is carried on by the jobbers. On the right-hand side, is given the landed-cost when the operation is carried on by company camps.

After the total landed-cost is obtained, the cost at the piles will be obtained by the addition of the transportation costs. The transportation as shown in the chart may consist of driving down the brooks to the main river, and then down the main river to the mill, or hauling from the landings to the mill by rail, or it may consist of driving down the brooks and then hauling by rail to the mill.

The woods manager wants a system which will enable him to follow closely the progress of his operations during the season. He thinks that such a system may be used despite the seasonal nature of the operations in the northern part of the country, and despite the fact that climatic variations, such as heavy rains or snow storms or any unusually mild weather, are so great as to make anything but general averages seem valueless to some woods operators.

He plans, like the old-time operators, to start his season's account for operation with an inventory of supply and equipment left over from the previous year. This inventory will be taken on or about April 1. It will be the final check on the past season's costs and the basis for all the next season's costs. The addition to the April 1 inventory account of all supplies and equipment purchased during the year, and the subtraction from this total of the inventory amounts of the next April 1 inventory, will show the total amount of supplies and equipment used in a given season's operations.

In order to know the costs of his operations, he must know what his supplies cost, not only at the point of purchase, but when actually consumed; what it costs to hire men and transport them to the camps; what these men actually produce; and what it costs to board them; the proper charges per unit of time to make for horses and machinery; and the amount of his camp production cost to be charged into each year's operations. He also wants this system to show the cost per cord of pulpwood cut, peeled, sawed, swamped, and piled at the stump, showing separately the cost per cord of wood cut by monthly men and wood cut by cord cutters, not only when the operation

is completed, but at the end of each week or month. He wants to know not only the cost per cord of the operation as a whole, but also the cost per cord at each camp in the operation.

The woods manager does not think that the cost of such a system will be excessive. He states that for an operation of from 20,000 to 40,000 cords, it is in any case necessary to have the following men: a camp clerk and scaler at each camp; a storehouseman at each storehouse; a chief scaler for each operation; a chief clerk for each operation. These men, he says, can do the necessary book work without undue effort. In his work preparatory to deciding on the accounts which shall be kept, the woods manager made up the following outline of the major items of expense:

1. *Labor*
   (a) Man
   (b) Horse
2. *Supplies*
   (a) Man
   (b) Horse
3. *Expendable Equipment*
   (Equipment that is consumed during the current year)
4. *Non-Expendable Equipment*
   (Equipment that is not wholly consumed during current year—sleds, spuds, harness, and so forth)
5. *Plant*
   (Depreciation and maintenance on camps, dams, streams, improvements, and so forth)
6. *Overhead*
   Supervision, Forestry, and so forth

He has looked over the list of logging accounts put out by the News Print Service Bureau, which is as follows:

CHART OF ACCOUNTS

Stores Accounts

Commissary Store Account
Commissary in Camps Account
Miscellaneous Supplies Stores Account
Miscellaneous Supplies in Camps Account
Equipment Stores Account

Equipment in Camps Account
Salvaged Equipment Account
Wangan Stores Account
Wangan in Camps Account
Wangan Sales Account
Sales to Jobbers and Outsiders Account
Inventory Adjustment Account
Railroad Freight (incoming) Account
Toting to Storehouse Account
Lost and Damaged Goods Account
Equipment Supplies and Wangan in Transit

Headquarters Camp Operating Accounts

Boarding House Account
Blacksmith Shop Account
Stable Account
Horse Tariff Reserve Account
Tractor Operating Account
Harness Shop Expense Account

Company Camps Operating Accounts

Camp Board Account
Blacksmith Shop Account
Horse Maintenance Account
Tractor Operating Account
Cutting and Yarding Account
Hauling Account
Camp Toting Account
Camp Overhead Expense Account
Idle Time Expense Account
Stumpage Account
Company Camps Yarded Wood Inventory Account
Farming Profit and Loss Account
Company Camps Landed Cost Account
Jobbers Operating Account
Jobbers Yarded Wood Inventory Account
Jobbers Landed Cost Account
Purchased Wood Account
Operation Overhead Expense Account
Total Landed Cost Account
Landed Wood Inventory Account

Drive Accounts

Driven Wood Adjustment Account
Subsidiary Drive Operating Accounts
(by individual drives)
Subsidiary Drive Inventory Account
Main Drive Operating Account

Main Drive Inventory Account
Driven Wood Cost Account

Cutting and Loading Plant

Wood in Boom Account
Operating Account
Pulpwood Pile Inventory Account
Transportation Account (Railroad, and so forth)
Railed Wood Cost Account
General Overhead Expense Account
Mill Boom or Yard Account

He has obtained in addition the following list of accounts which are used by a large paper mill in the Province of Quebec in its logging operations.

Supply Stores

Wages, Store-Keeper and Clerks
Repairs to Storehouse, and so forth
Sundry Expenses
Teaming
Loss and Shrinkage

Stable

Hostlers and Helpers
Repairs to Buildings
Repairs to Wagons and Sleighs
Repairs to Shoes
Repairs to Harness
Feed and Bedding
Hired Teams
Tools and Miscellaneous Supplies (unprovided for and veterinary)
Fuel
Shop Expenses

Fire Protection

Wages, Watchman
Wages, Fire Rangers
Fire Rangers' Expenses

Depots and Boarding Camps

Labor, Cook, and so forth
Repairs to Buildings
Repairs to Equipment
Tools and Miscellaneous Supplies
Provisions

Freighting Pulpwood
Loading on Cars
Unloading Cars
Hauling to River
Freight
Miscellaneous Supplies, and other charges

Freighting Logs
Loading on Cars
Unloading Cars
Other Labor
Freight
Repairs to Machinery and Miscellaneous Supplies

Limit Cut Expenses
Cullers, Wages
Cullers, Expenses
Government Dues
Ground Rents
Teaming Horse-time Only

Cullers Wood Department
Cullers, Wages when Idle
Cullers, Expenses
Teaming Horse-time Only

Private Land Cut Expenses
Cullers, Wages
Cullers, Expenses
Teaming Horse-time Only

Surveying and Exploring Bushmen
Surveyors' and Explorers' Time, and so forth
Carpenter, and so forth

Forestry
Salary of Foresters
Expenses of Foresters

Limit Telephones
Wages and Expenses
Tools, and Miscellaneous Supplies, and so forth

Tractor Operating Account
Wages
Repairs to Tractors
Repairs to other Equipment
Gasoline and Oil
Tools, and Miscellaneous Supplies

Logging Camps

Foreman, Clerk, and Cullers
Log Making
Jobbers Log Making
Hauling
Piling
Camp Building
Main Road Making
Portaging
Equipment
Provisions
Stable Cost
General Expenses, Cook, Chore-Boy, Blacksmith, and so forth

Drives

Foreman and Clerk
General Labor
Equipment and Supplies
Repairs to Drive Improvements
Board of Men (may be charged with cook's labor)
General Expenses
Damages Flooding Lands
Horse Feed and Bedding
Rouge River Improvement Tolls

Repairs to Construction Work in Progress

All work on special orders will be charged to the respective order numbers under the above general heading.

Outside Parties

All sales of stores for outside parties, jobbers, and members of staff will be charged to this account.

What accounts should be kept in order to obtain the costs which the woods manager desires? Are all these costs necessary? If not, which ones should be eliminated?

B. HARDWARE AND METALS

4. INDIAN HEAD STOVE FOUNDRY COMPANY—STOVE FOUNDRY COSTS

In the spring of 1922, price recessions in the stove industry focused the attention of the management of the Indian Head Stove Foundry Company upon the cost of individual stoves. It had been an old rule in the stove business that if the direct-

labor and material costs were doubled to establish a price, there would be a sufficient margin to include manufacturing overhead, selling expenses, and profit. Realizing the inadequacy of this rough, rule-of-thumb method, the company had adopted the cost system recommended by the National Association of Stove Manufacturers, which collected direct costs by department, and added a percentage overhead for each department based on past experience. In using this system, the Indian Head Company had found, however, that as percentage overhead charges were based upon direct costs, it was impossible in times of rapidly changing wages and material prices to get reliable results. The firm also found that it lacked sufficient information to determine these overhead percentages scientifically, and that in applying the percentage overhead of departments it was difficult to prorate the expense so that both large and small pieces received a fair portion of the expense.

In the manufacture of more than 100 different models of stoves the following processes were necessary:

1. *Melting.* The cast iron and coke, which had been received at the stock shed, were raised and dropped into the cupola, where with the addition of a small amount of limestone, the whole was melted. The men in charge of the melting were paid by the day.

2. *Pattern Making.* In order to supply patterns used in making the molds, the Indian Head Company maintained a pattern shop and pattern storehouse. The pattern makers were day-workers and used wood, iron, and nails as their chief materials.

3. *Core Making.* In order to leave the proper spaces in a finished casting, cores of sand were made in metal forms in the core shop, and baked in the ovens. All core makers worked on a piece-rate basis.

4. *Molding.* The casting molders packed the sand in boxes around the patterns, removed the patterns, set the cores, and placed the flasks for pouring. Both core and casting molders were unionized throughout the trade, and received a uniform piece-rate. This scale of rates was determined once a year. The molders had no helpers, two or three of them joining to-

gether to help one another on heavy work. Under union regulations but one apprentice is allowed for every 15 molders. These apprentices received reduced piece-rates.

5. *Breaking Out the Castings.* When the castings had cooled they were broken out of the molds by the floor gang in the foundry, whose duty it was to charge the cupola, supply the molders with ladles of molten iron, and remove the finished castings from the molds. These men were paid by the day. The sand, however, was cut, or moistened, so that it would pack readily in new molds, by extra men who worked after hours on a piece-rate or job basis.

6. *Cleaning and Grinding.* The castings were sent from the foundry to the cleaning room, where they were put in large revolving cylinders to shake off the layer of sand with which they were encrusted when taken from the molds. All irregularities were chipped off by hand, and the castings were ground smooth by men working on a day basis. Spoilage in this process was about 1%.

7. *Inspection and Racking.* A close inspection followed, after which the finished castings were stored in bins by men who were paid by the day.

8. *Nickel Plating.* Castings which required a nickel finish were sent to the plating room, where the work was done by men who were paid by the day. The chief materials were nickel annodes and salts. The plating is done by suspending the pieces for a certain time in a tank filled with solution.

9. *Mounting and Fitting.* The castings for the coal ranges went from the racks to the mounting shop, where the body of the stove was assembled by piece-workers. The materials used included bolts, rivets, washers, cotters, rods, knobs, linings, door linings, asbestos, cement, plaster, and putty.

10. *Blacking.* The assembled bodies were then blacked on a piece-work basis.

11. *Trimming and Packing.* After the bodies were assembled, the stoves were fitted out with the necessary accessories called "trimmings," such as shovels, lifters, towel rods,

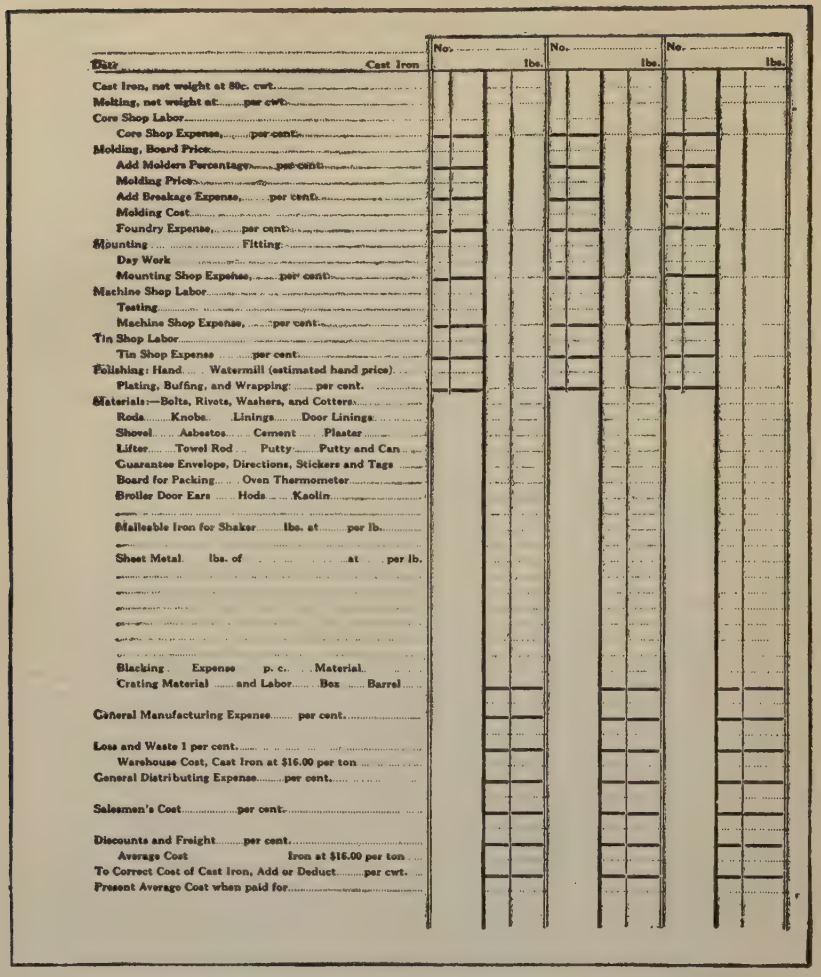
guaranty envelope, directions, stickers and tags, oven thermometer, boiler door ears, hods, and kaolin, by men who worked on a piece-rate. The completed stove was then submitted for final inspection, crated, and placed in the warehouse to await shipment. Warehouse men were paid by the day.

As the bodies of gas and electric stoves were similar, the main difference in processes consisted in assembling. Sheet metal for ovens was japanned in the japan room. A small amount of waste occurred in poor cutting of iron sheets. The electric parts, such as heating units, switches and wiring, and gas parts, such as gas cocks, pipe and fittings, were bought outside.

In mounting, each stove was given a serially numbered card with several coupons attached, the mounters, trimmers, and warehouse men each detached a coupon in turn, which was sent to the office to be checked against the records. Purchases were made by the manager according to requisitions made out by each department head. As there was no central storeroom, each department kept its own supplies. There was no check on issues to workmen, even in the gas and electric assembling room.

The company kept a record of charges to its capital account. Adequate depreciation charges were made, but there was no attempt to allocate this properly over departments, and thus over the product. Maintenance and repairs constituted a large item in the overhead. Power was purchased, but here again there was no accurate method of distributing this expense to departments. Pattern work was charged to capital and written off by depreciation. Freight was charged as cost of raw materials, but labor in loading and unloading was overhead. In addition to the waste already mentioned, a charge of 1% of the total general manufacturing expense was added to cover indeterminate loss and waste. Payment of wages was made weekly throughout the plant. There was a timekeeper and a superintendent in the foundry, and a foreman in charge of each process, except pattern making, nickel plating, and blacking. There were nine clerks, bookkeepers, and stenographers in the office, in addition to the manager. Costs were divided roughly as direct labor 50%, material 15%, overhead, including indirect labor, 35%.

The cost sheet illustrated in Form 36 was used by the Indian



Date	Cast Iron	No. lbs.	No. lbs.	No. lbs.
Cast Iron, net weight at 80c. cwt.				
Melting, net weight at ... per cwt.				
Core Shop Labor				
Core Shop Expense, ... per cent.				
Molding, Board Price				
Add Molders Percentage ... per cent.				
Molding Price				
Add Breakage Expense, ... per cent.				
Molding Cost				
Foundry Expense, ... per cent.				
Mounting ... Fitting				
Day Work				
Mounting Shop Expense, ... per cent.				
Machine Shop Labor				
Testing				
Machine Shop Expense, ... per cent.				
Tin Shop Labor				
Tin Shop Expense ... per cent.				
Polishing: Hand ... Watermill (estimated hand price)				
Plating, Buffing, and Wrapping: ... per cent.				
Materials:—Bolts, Rivets, Washers, and Cotters				
Rods ... Knobs ... Linings ... Door Linings				
Shovel ... Asbestos ... Cement ... Plaster				
Lifter ... Towel Rod ... Putty ... Putty and Can				
Guarantee Envelope, Directions, Stickers and Tags				
Board for Packing ... Oven Thermometer				
Broiler Door Ears ... Hods ... Kaolin				
Malleable Iron for Shaker ... lbs. at ... per lb.				
Sheet Metal ... lbs. of ... at ... per lb.				
Blacking ... Expense ... p. c. ... Material				
Crating Material ... and Labor ... Box ... Barrel				
General Manufacturing Expense ... per cent.				
Loss and Waste 1 per cent.				
Warehouse Cost, Cast Iron at $16.00 per ton				
General Distributing Expense ... per cent.				
Salesmen's Cost ... per cent.				
Discounts and Freight ... per cent.				
Average Cost ... Iron at $16.00 per ton				
To Correct Cost of Cast Iron, Add or Deduct ... per cwt.				
Present Average Cost when paid for				

Form 36: Cost Sheet—Indian Head Stove Foundry Company

Head Manufacturing Company in determining the cost of its products. Each column was intended to show the costs of manufacturing all the stoves of one kind turned out during the period, the number produced appearing at the head of the column. Melting expense included coke and labor at the cupola, but no overhead. Molders' Percentage was an addition made to the Molders' Piece-Rates, subject to adjustment from time to time. Machine Shop Labor was engaged in machining and

drilling holes in various parts of the stoves; but it was estimated that some 35% to 40% of it was devoted to repair and construction work on the plant and machinery of the company.

The term direct labor, as used in the stove industry, is limited to certain classes, such as molding in the foundry, mounting in the mounting department, and polishing in the nickel department. Other classes of labor in these departments are termed indirect, though they may be directly productive; indirect labor thus amounts to considerable proportions.

It will be observed from the sheet that cast iron is charged into manufacturing at a standard rate, which is corrected later for any variations in the market price.

5. RED METAL MANUFACTURING COMPANY—SECTION A—COST ACCOUNTING SYSTEM FOR A BRASS CASTING, MILLING AND FABRICATING CONCERN

The plant of the Red Metal Manufacturing Company is divided into three distinct divisions, both for physical and for cost accounting reasons. The casting division receives scrap and new metals, combines them into various mixtures by the use of electric and coal furnaces, and pours them into billets and bars for use in the milling division. The milling division rolls and draws the billets and bars into sheets, rods, wire, and tubes. About one-third of the production of the milling division is sold to outside customers. The balance of its production is sold to the fabricating division of the Red Metal Company, where small articles for use in the automobile, electric, and plumbing trades are fabricated.

A. The Cost Accounting System

1. *General Books.* The cost accounting system of the Red Metal Company is tied into the general accounting system by means of an account for each division carried in the general books, which corresponds with a "general ledger account" carried in the cost books of each division.

B. Casting Division

1. *Materials.* The chief direct materials are copper, zinc, lead, and scrap. The scrap is made up of brass of varying mixtures and occasionally some copper. Material is charged on

the general books to the casting division at the actual price plus transportation costs. Material is accordingly credited in the "general ledger" account in the casting division ledger at this same actual rate, but it is charged to the metal stores department at a standard rate established at the beginning of the year, on a basis of the market at that time. Any difference between the actual and standard costs of the material is immediately charged or credited back to the general books, where it becomes a part of a purchase adjustment account. The metal stores account of the casting division, therefore, represents at all times the unused inventory of raw material at a standard rate.

All production of the casting division is applied against actual orders or requisitions from the milling division. Material is charged to orders by the metal stores department at the same standard rate at which it was originally charged to stores.

During the melting and pouring process, there is a considerable wastage of material which becomes mixed with dirt and ashes. This waste is collected and sent to a reclaiming plant, where the metal can be segregated from the dirt and ashes and returned to the metal stores for future use. One end of the billets and bars coming from the mold must be sawed off and discarded owing to the fact that considerable impurity gathers at that end. These ends, known as "gates," together with any defective material, are also returned to the metal stores department for future use. The wastage and "gates" usually amount to about one-third of the original gross metal charged to the order. Standard rates are made up for each different mixture of metals and are based upon the standard rates at which the ingredients originally are charged to the order. "Gates" and defective material are credited to the order at the standard rate for the mixture of which they are composed. The determination of a credit due an order, because of waste material sent to the reclaiming plant, forms a more difficult problem which has been handled in the following manner: The gross weight of metal originally charged to the order is known; the net weight of billets and bars after removing "gates" is known; a small allowance, based on experience, is made for shrinkage during the heating process, and the remaining weight, unaccounted for, is assumed to have gone to the reclaiming plant. It is credited to the order at an arbitrary standard rate, which

is approximately two-thirds of the original standard for the mixture.

The ashes and sweepings from a given order are charged to the reclaiming plant at the same amount for which the order was credited. The reclaiming plant is, of course, charged with all labor and indirect expense incurred in its operation. It is credited with all reclaimed scrap at a standard rate, which is the arithmetic average of all standard rates for all mixtures. Metal stores are charged for reclaimed scrap at this same average standard rate.

2. *Direct Labor and Overhead.* Both direct labor and overhead are applied in the casting division by a furnace-hour rate which was developed after long tests by engineers. All furnaces are capable of performing any kind of work which passes through the casting division. The furnace-hour rate includes the wages of the men tending the furnaces, as well as a proportion of all other charges incurred in the casting division; these have been charged to one account, called overhead. Timekeepers record the exact amount of time spent on each order by each furnace, and, at the end of the day, turn in a record known as a log, which gives a detailed account of the operations of each furnace during that time. From these log sheets the cost accounting department can determine the charge to be made against each order for the operations performed in the casting division.[1] The production of the casting division is credited to the division at the standard rate for the net material plus the charges based upon the furnace-hour rate.

3. *Idle Time.* At the end of each month the difference between the debits to the casting division for wages and overhead, and the credits resulting from the application of the furnace-hour rates to orders, is cleared to a burden adjustment account for the division, and is immediately washed through to a profit and loss account for the division in the general books. This monthly entry in the burden adjustment account provides for the management an index of the efficiency or possible idleness of the division. Continued variation in one direction of the burden account, except as a result of idleness, is corrected by alteration of the furnace-hour rate. This rate, as well as all

[1] *See* Red Metal Manufacturing Company, Section B, pp. 226 and ff.

standard costs used throughout the system, is subject to change whenever necessary. A per-pound cost for casting is worked out each month for each mixture.

4. *Scrap Preparation.* Brass scrap is received in all forms, from irregular sheets and tangled wire to fine chips. The scrap is pressed into blocks about a foot long and half a foot square to facilitate its handling and weighing. The labor and all the indirect charges for putting scrap into this shape are distributed with the metal stores costs through the furnace-hour rates. Material leaving the casting division is charged into an intermediate stores known as the billets and bars stores, from which it is requisitioned by the milling division. A few shapes require cores. These are made in a separate department, the costs of which are included in the furnace-hour rate applicable to those particular shapes.

C. The Milling Division

1. *Intermediate Departments: Hot Rolling, Piercing, and Extrusion.* The milling department manufactures only on specific orders from outside customers or from the fabricating division. Orders for similar materials are grouped into larger mill orders against which all charges are made. Billets and bars, withdrawn from intermediate stores, are charged against the order at the same price at which they were charged into intermediate stores. Goods for use in the sheet mill must pass through the hot rolling process; for use in the tube mill—through the piercing process; for use in the rod or wire mill, through the extrusion process. These three intermediate operations are charged against the order at a machine-hour rate, which includes the wages of the operators and the machine's share in overhead expenses.[1]

Orders proceed after the intermediate operation to one of the

[1] Each intermediate department is located in a separate building, which facilitates segregating costs. Normal production was determined by measuring the capacity of the departments in the mill fed by the intermediate departments. Inasmuch as the two chief variables were direct labor and power, three or four rates were computed for each machine according to the size of the material worked upon. Power and labor could be directly apportioned to sizes by knowledge of their actual requirements; burden was apportioned on a basis of the proportion of time during which the various sizes occupied the machines under normal conditions. The machine rates were constructed in a manner similar to the furnace-hour rates, except that the process was more simple.

four mills where the necessary rolling, drawing, annealing, washing, and polishing operations are performed. Each mill is broken up into production centers of varying composition. A production center may consist of a group of annealing furnaces known as muffles; it may consist of a group of identical machines, or a group of machines performing several operations; a production center may consist of a group of machines through all of which an order must pass or through only one of which it must pass. Machines which take the same overhead loading are grouped. This varies from 150% of direct labor in the case of small, light machines to 900% in the case of heavy, large machines using much power. The timekeepers record the amount of time during which each order is in process in each production center. Actual direct labor is first charged against an order, then overhead which includes all other charges is applied as a percentage of the direct-labor cost incurred in the production center, in those cases where no machine rate is yet operated. Most labor in the mill is on task-and-bonus system, which is reduced to a flat hourly rate for each center to facilitate charging product. It is the aim of the management eventually to establish a rate for every machine in the mill.

2. *Salvage.* Goods spoiled in the mill, which are capable of being manufactured into a slightly different product, are charged to an account known as "salvage stores," in the following manner. The material is charged at the standard rate for the mixture of which it is composed, plus an arbitrary figure of 80% of the actual labor and overhead applied during the previous operations in the mill. The order is credited with the amount which is debited to salvage stores. Goods which are spoiled beyond repair are returned to the metal stores department of the casting division, to which they are charged at the standard rate for the material. The order in the mill is credited with this value of the material, but it must absorb the total labor and overhead incurred by the spoiled goods during the previous operations.

3. *Packing, Selling, and Administration.* A uniform per pound package-charge is added to the factory cost of all goods requiring boxing. All product which is sold either to the fabricating division or to outside customers is credited to the mill

at cost. Selling and administration costs are added in the general books as a percentage of factory cost. Sales are made to the fabricating division at the same price as to outside customers, less the usual selling expense. For balance sheet purposes, sales to the fabricating division which have not been liquidated by sales of fabricated articles are retained in a separate account against which a constant reserve is kept, since no real profit accrues to the company from an interdivisional sale.

4. *Idle Time.* Idle time is cared for in a manner similar to that used in the casting division. The difference between charges to the milling division for labor and overhead and debits to individual orders for work accomplished is cleared monthly to a burden adjustment account, which in turn goes to the general books to a profit and loss account for the milling division.

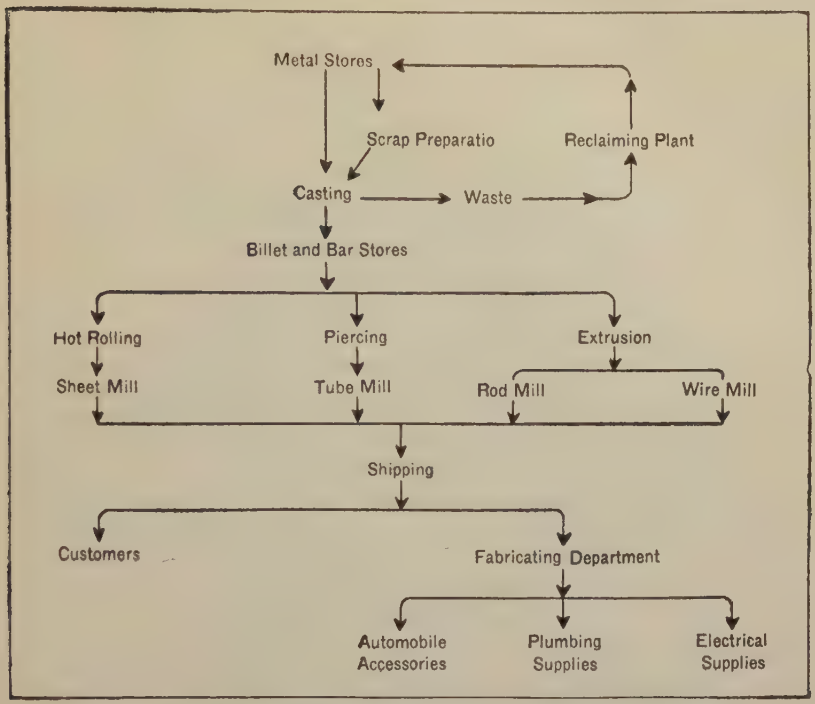
D. The Fabricating Division

The fabricating division manufactures about 100 different articles which fall into three groups, automobile accessories, plumbing supplies, and electrical supplies. The division is broken up into about 20 departments according to function. Sheets, wires, and rods purchased from the milling division are called direct material, and are charged to orders either for customers or for stock at the actual price paid the milling division. All materials which are purchased from outside parties and which actually enter into the product, such as small castings, paints, lacquer, and wooden parts, are known as supplies and are charged to the orders at their actual cost. Indirect supplies become a part of the departmental overhead.

1. *Labor.* Almost all direct labor in the fabricating division is on a piece-work basis and is charged against the various orders on that basis.

No attempt is made to keep interdepartmental inventories. Only one work-in-process account serves the division. Finished goods in stock remain as part of the work-in-process controlling account until actually sold.

2. *Overhead.* An important feature of the fabricating division cost operations is a book known as the Register, which contains the standard practices concerning the materials, processes,



Form 37: Process Chart—The Red Metal Manufacturing Company

and labor required for the completion of each article. This book is compiled from test runs and from experience. The various overheads of the departments have been combined under five headings, each of which applies to one of five groups into which the products have been gathered for the purposes of facilitating the application of overhead. The overhead is charged against the orders as a percentage of direct labor. Commercial expense is added as a percentage of total factory costs, as in the case of the milling products sold to outside customers. Products of the fabricating division, which have been sold, are credited to work-in-process at a standard rate which is supposed to equal fabricating cost. Monthly reports showing actual expenditures in the division enable the standard rates to be checked and alterations made where necessary.

Idle time and inefficiency are indicated in the burden adjustment entry which is made as in the other divisions and credited to divisional profit and loss in the general books.

Scrap in the fabricating department amounts, in the aggregate, to a considerable weight, but as it is produced in small quantities and at several points during the process, no attempt is made to credit individual orders or even departments with scrap value. The general work-in-process account of the division, however, is credited with scrap returned to the metal stores department at the standard rates for the mixtures returned.

General

Each division has several service departments, such as tool and die rooms; internal transportation, including cranes, trucks and the like; heating, power, and divisional administration. All such departments are thrown into the general overhead in the casting division, into production-center overhead in the milling division, and into departmental overhead in the fabricating division.[1] No general divisional overhead accounts are employed.

List of Accounts

Mill and Casting Divisions

1. *General Ledger*

2. *Service Departments*
   - (a) Works Manager's Office
   - (b) Works Accounting
     (and similar accounts for all service departments; in some cases subdivisions are provided for direct labor, overhead, and material)

3. *Productive Departments—Casting*
   - (a) Scrap Preparation
   - (b) Metal Storage and Weighing
   - (c) Furnace Casting, Gating, Weighing, and Shearing—Direct Labor and Overhead
   - (d) Core Making

4. *Productive Department—Intermediate*
   - (a) Piercing
   - (b) Extruding
   - (c) Hot Rolling

5. *Productive Department—Milling*
   - (a) Tube Making—Direct Overhead
     (and similar accounts for each production center)

[1] *See* Red Metal Manufacturing Company, Section C, pp. 234 and ff.

6. *Miscellaneous*
   - (a) Workmen's Compensation
   - (b) Group Insurance
   - (c) Inventory Adjustment
   - (d) Scrap Adjustment

7. *Process Accounts*
   - (a) Material in Process—Casting
     Hot Rolling
     Extrusion
     Piercing
     Tube Mill
     Sheet Mill
     Rod Mill
     and so forth
   - (b) Labor and Overhead in Process—Casting
     Hot Rolling
     and so forth

8. *Primary Accounts*
   - (a) Direct Labor
   - (b) Supervision
   - (c) Timekeeping
   - (d) Employment
   - (e) Hospital and Welfare
   - (f) Cleaning and Sweeping
   - (g) Watchman
   - (h) Water
   - (i) Gas
   - (j) Coal
   - (k) Maintenance and Repairs—Buildings
     Land
   - (l) Depreciation—Machinery and Equipment
     Buildings

   (and similar accounts, for whatever items exact costs are desired, either temporarily or permanently)

6. THE PERUVIAN SMELTING AND REFINING COMPANY—DESCRIPTION OF PROCESS AS A BASIS FOR COST ACCOUNTING SYSTEM

The Peruvian Smelting and Refining Company receives copper ore from mines located in South America, and also some blister copper and concentrates from mines in the western part of this country. The company's smelter, which ranks among the smaller plants of the country, has an annual capacity of about 200,000 tons of ore.

Description of the Plant

A. *Receipt of Materials.* South American ore is received in shipload lots at the company's dock, which is located at the plant, on the eastern seaboard. The ore is unloaded directly into cars operated on the internal light railway of the company and is transported immediately to storage bins. A sample of each lot of ore is then tested in the company's laboratories, and an assay is made of its copper content and for any content of precious metals. On the basis of this assay, the producing mine is paid for the ore.

The company owns two blast furnaces, only one of which is operated at a time in order to allow the other to be repaired. These furnaces, which are heated by soft coal, are charged at short intervals with small amounts of ore. Charges for the blast furnaces are prepared by mixing the various lots of ore received in such proportions as to give a desirable finished product. Often, however, ore from an individual mine is in shape to charge immediately into the furnaces without the addition of other ore. As the ore melts, the slag, which has practically no copper content, comes to the top and automatically overflows into a sluiceway, where it is carried by running water to a dump. Copper is poured from the blast furnaces at frequent intervals in crucible lots of about two tons; consequently the blast furnace is in continuous operation except when undergoing repairs.

The product of a blast furnace is known as matte, which contains from 50% to 75% copper. The matte is carried in a molten state immediately to a converter, which is a blast furnace of somewhat different construction, but which performs substantially a similar operation to that already completed. The converter is charged about every half-hour as the crucibles come from the blast furnace. Pouring takes place at correspondingly frequent intervals. Slag from the converter is returned to the blast furnace for resmelting. The product of the converter is known as blister, which is about 97% pure copper. The blister is poured into crucibles and carried to a large cylindrical furnace, in which it is kept in a molten state during the process of pouring into molds. By this process slabs about four inches thick and two feet square are produced. These slabs are characteristic shapes for blister copper, known as pigs. At this point in the process, careful sampling is again necessary. This is ac-

complished by selecting about 10% of the pigs from any lot of blister, whether coming from the company's smelter or from the West, and boring a hole at a different point in the surface of each of the sample pigs. The chips from the various borings in a given lot are well mixed and sampled until a sufficiently small quantity is obtained to handle in the laboratory. From these analyses the value of purchased blister is determined, and the mixtures are made up for melting in the anode furnaces.

There are four anode [1] furnaces, two of which are usually in operation at a time, while the other two are being repaired and charged. These furnaces are charged with blister pigs, and are sealed and fired by oil for 24 hours, when they are ready for pouring. Slag from the anode furnaces returns to the converter. The product of the anode furnaces, which is from 98% to 99% pure copper, is known as anode copper. This is poured into thin sheets about 2½ feet square, on two corners of which are ears that support the plate when suspended in the electrolytic solution during the process of refining. The anodes are transported to the tank house by overhead cranes in lots of 20 to 30 sheets suspended on racks of parallel bars.

The tank house is a large building filled with rows of wooden tanks containing copper sulphate. The anodes are suspended in the copper sulphate about two inches apart, the ears resting upon two bars on either side of the tank which are charged positively with electricity. Between every two anodes is suspended a thin sheet of pure copper known as a cathode.[2] The cathodes are charged negatively. By electrolysis the anode enters into the solution and the copper is deposited upon the cathode, while any impurities, including gold, silver, or other precious metals, settle to the bottom and form a black mixture known as slime. The portion of the anode which is out of the solution and the thin remainder of the anode sheet are returned to the anode furnace for resmelting. The cathodes are transported to the wire bar furnaces, of which there are four, two

[1] So called because the product is poured in shape for use as anodes in the electrolytic refining of copper.

[2] These cathode starter sheets are made in one end of the tank house by means of depositing a thin layer of pure copper on a heavy sheet of a different material by electrolysis. These thin layers of copper are then pealed off and attached by means of rivets to a couple of loops, made of thin sheet copper, by which the cathode starter sheets are suspended in the solution.

in operation at a time. These furnaces serve merely to melt the pure metal and enable it to be poured into any shape desired for commercial use. The more common shapes are wire bars, ingots, ingot bars, and cakes; these are the salable products of the Peruvian Refining and Smelting Company. All electrolytic copper must be at least 99.9% pure, and conform to several other technical requirements regarding conductivity and chemical content. It is for this reason that sometimes the laboratories find it desirable to mix different ores in the original charges for the blast furnaces.

The slime from the electrolytic tanks goes to the silver refinery where it is thoroughly washed to remove some impurities, especially any small residue of copper, and is then roasted and smelted in small furnaces from which are poured slabs of silver known as Doré plates. The Doré plates are suspended in a chemical bath, and by electrolysis the pure silver is deposited on carbon sheets, and the impurities, including gold, platinum, and other precious metals, drop to the bottom in the form of slime. The silver is then melted and cast into bars of 500 ounces and 1,150 ounces. The slime from the silver tanks is passed through several processes by hand during which it is washed with chemical compounds, roasted, smelted, and refined, finally producing pure gold, platinum, and other metals.

The smelting and refining plants naturally fall into the following departments:

Blast Furnaces } Are housed in the same building
Converters }
Anode Furnaces
Tank House
Wire Bar Furnace (Housed in same building with Anode Furnaces)
Silver Refinery (All work on precious metals is carried on in silver refining building)

Internal Transportation. The light railway is operated by small steam locomotives. The time of this railway is not evenly divided among the different departments, but during one week it may be occupied with unloading a couple of ships; at another time large shipments of finished product may require most of its time; and then again movement of coal for the smelter may

need it for a while. There is always a certain amount of routine movement of pigs from the smelter to the sampling plant, to the anode furnace, and the corresponding movement of finished shapes to finished products stores or railway cars.

Laboratory and Sampling. This department, although a service department, is one of the most important in the plant. Here the mixtures are determined which in turn control the quality of the finished product; and laboratory assays are the sole basis for determining the amount of copper for which the producing mine shall be paid.

Machine Shop. The machine shop does some new construction work, but the bulk of its time is occupied with repairs for the light railway, and for any of the other departments using machinery.

Foundry. The foundry makes and repairs molds for use in pouring pigs, anodes, and marketable shapes. Some of these molds are constructed of copper which can be remelted when worn out; others are manufactured of iron and must be scrapped when worn out.

Power Plant. Manufactures electricity for the tank house and for general use throughout the plant. Oil fuel is used in the power plant.

Stores. This department includes the following subdivisions:

(a) Ore Stores
(b) Blister Stores
(c) Finished Product Stores
(d) Fuel Stores
(e) General Supplies

Administration. Includes:

(a) General Offices
(b) Hospital
(c) Lunch and Recreation Rooms

Principal Items of Cost

Labor. Direct labor is employed chiefly in operating cranes and furnaces. It occurs at the following points:

Unloading ore—Crane and light railway (gang of laborers who work all over plant)	30 men [1]	
Making up charges—hand shoveling	6 men	
Charging and pouring blast furnace	3 men	
Stoking blast furnace and converter (coal)	2 men	
Pouring pigs and removing from molds	3 men	
Charging and pouring converter	2 men	
Crane operation in furnace house	1 man	
Loading, unloading and transporting pigs to intermediate stores	3 men	
Loading pigs on cars and transporting to anode furnace	6 men	
Charging anode furnaces by crane	2 men	each furnace
Firing anode furnaces (by oil)	2 men	
Pouring anode furnaces and emptying molds	5 men	each furnace in operation
Crane conveyers in tank house	4 men	
Making cathode starters	6 men	
Placing and removing cathodes and anodes	30 men	
Crane conveyor to wire bar furnaces	2 men	
Crane charging	2 men	
Pouring and emptying molds, wire bar furnace	5 men	each furnace
Transportation (light railway to stores)	3 men	
All labor in silver refinery (direct)	8 men	

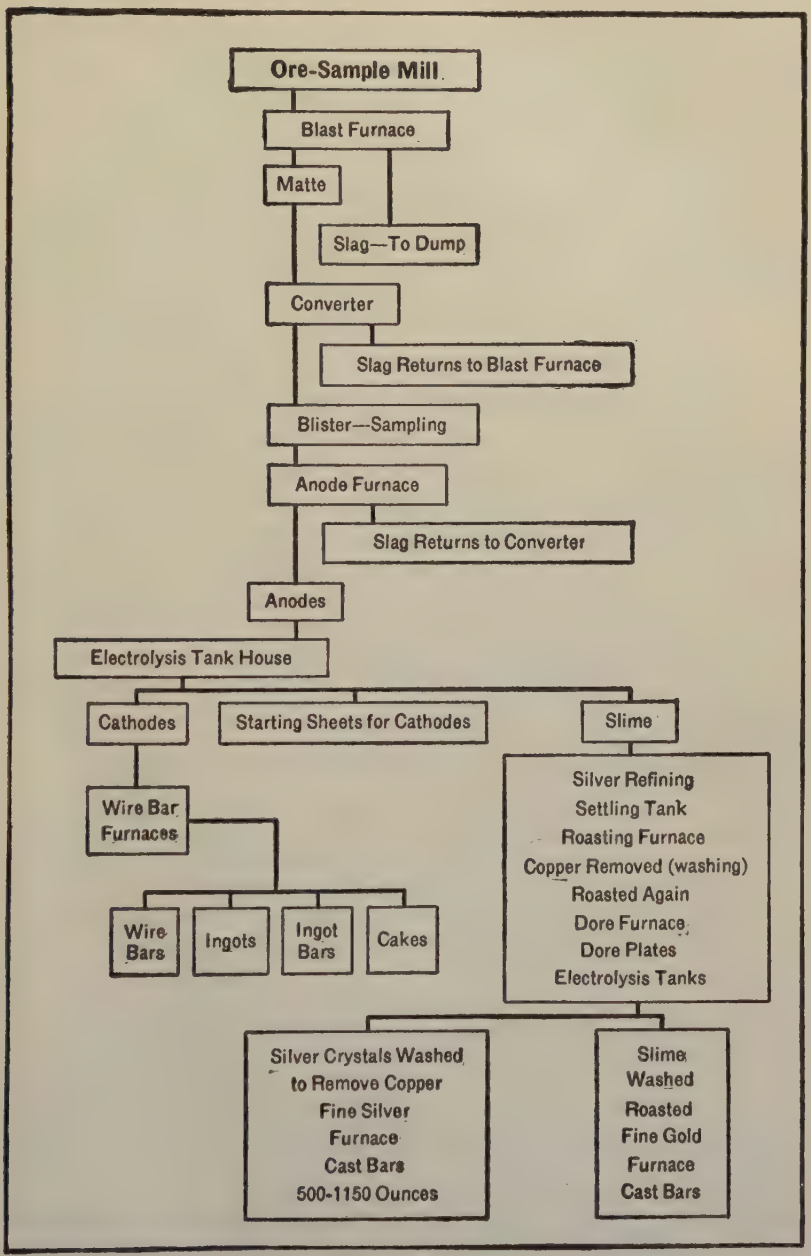
Indirect labor comprises about 60% of the total, and includes the employees of the service departments exclusive of the light railway.

Materials. The chief indirect materials are coal and oil fuel for the furnaces and railway; copper sulphate for the tank house; and bricks and mortar for repairing the furnaces, which is a large item since the extreme heat makes repairs necessary every few days.

Power. This is an important item since large amounts of electricity are used by the tank house and by the cranes.

Overhead. Expensive plant and equipment result in large

[1] The labor figures are only approximate.



Form 38: Process Chart—The Peruvian Smelting and Refining Company

fixed charges; the heat and fumes cause rapid deterioration of equipment and make maintenance expense large. A large amount of land is required for storage of coal, ore, and finished product.

The chief difficulty in accounting is to allocate properly the work done by the service departments to productive departments. Gangs of men who work where needed, and the light railway which serves the whole plant, are especially difficult to apportion.

7. BRUNO IRON WORKS—SUMMARIZING THE COST DATA

The Bruno Iron Works has a cost system which provides for the charging of materials, labor, and burden to the various departments and products, upon a basis which gives accurate debits to these accounts. There is, however, no regular means for crediting the manufacturing account for finished products, nor, consequently, for giving an accurate book inventory of work in process. During the last few years the company has several times changed its methods of summarizing the cost figures, and working out the inventory at the end of the period.

The original method is illustrated briefly by the following figures:

	Weight	Amount	Cost per Pound
Inventory in Process, Beginning	100,000	$ 5,000	$00.05
Input:			
Material	200,000	4,000	00.02
Labor		2,000	00.01
Burden		6,000	00.03
Total Inventory and Input	300,000	$17,000	$00.0566
Credit Output Finished	200,000	11,333	00.0566
Balance, Final Inventory	100,000	$ 5,667	$00.0566

Evidently this method puts the same value per pound upon the Work in Process Inventory at the end as upon the finished output, though the inventory includes goods in all stages of completion.

An attempt was therefore made to get more accurate figures by weighting the final inventory as if it were, on the average, only half completed. The precise method of doing this is shown in detail in the "Procedure for Computing Work in Process Cost Sheets."

Taking the figures shown in Form 39, fill in the remaining spaces by computing appropriate figures for Material, Labor, Expense, and total cost for the Transfers Out—Current Month, Total Transfers, and Inventory at End, in accordance with the instructions given.

This cumbersome procedure has evoked much criticism, and they are looking for a more satisfactory method. What would you recommend?

What changes in the regular current accounting methods of the Bruno Iron Works would remove any necessity for the above calculations? How feasible do you consider your suggestions (a) in a plant making 35 different articles, (b) in a plant making several thousand articles?

PROCEDURE FOR COMPUTING WORK IN PROCESS COST SHEETS

1. Analyze current month charges on ledger sheets as to Material, Labor, and Expense.

(a) Prove figures entered in their respective columns by adding across, and total should be the difference between debits and credits on ledger sheets.

2. Add current month input to two previous months' input plus inventory first of quarter.

(a) Prove figures by adding across, and total should equal the addition of the total column for these same figures.

3. Compute pound cost of total material column by dividing total weight by total value.

(a) Prove figures by multiplying back.

4. Add weight of current month's transfers to total weight of previous two months' transfers, arriving at weight of three months' transfers.

5. Multiply total weight of transfers by pound cost arrived at in Number 3 operation, giving the material cost for total three months' transfers.

6. Subtract total of value in material column of previous two months' transfers from total of three months' transfers, arriving at cost of current month's transfers.

7. Compute material cost per pound for current month's transfers

Cost Sheet—Month of November, 1922

	Net Material in Process			Labor in Process		Expense in Process		Total Cost	
	Weight	Value	Value per Pound	Amount	Cost per Pound	Amount	Cost per Pound	Amount	Cost per Pound
Inventory—September 1	219,539	21,287.38	.096964	3,014.05	.013729	5,306.48	.024171	29,607.91	.134864
Input—Month of September	121,022	12,043.87	.099518	2,710.89	.022400	4,835.43	.039955	19,590.19	.161873
Input—Month of October	90,150	6,786.58	.075281	3,024.80	.033553	6,763.05	.075020	16,574.43	.183854
Input—Month of November	165,832	12,030.12	.072544	2,739.54	.016520	4,980.27	.030032	19,749.93	.119096
Total	596,543	52,147.95	.087417	11,489.28	.019260	21,885.23	.036687	85,522.46	.143364
Transfers Out—Month of September	92,666	9,065.61	.097831	2,421.36	.026130	4,258.37	.045954	15,745.34	.169915
Transfers Out—Month of October	78,094	6,310.39	.080805	2,610.06	.033422	5,541.16	.070955	14,461.61	.185182
Total	170,760	15,376.00	.090045	5,031.42	.029465	9,799.53	.057388	30,206.95	.176898
Transfers Out—Current Month	87,907								
Total Transfers									
Inventory at End									

Form 39: Cost Sheet—Bruno Iron Works

by dividing value of current month's transfers by the weight of current month's transfers.

8. Subtract weight and value of total three months' transfers from weight and value of total arrived at in Number 2 operation, arriving at inventory of weight and material value of inventory. The pound cost is the same as the pound cost of total three months' transfers.

9. Divide inventory of weight at end by two, and add to weight of total three months' transfers for figure to use in computing average labor and expense pound cost.

10. Divide total of labor in Process, as arrived at in operation Number 2, by the above figure (Transfers plus 50% of inventory), arriving at average labor cost per pound.

11. Multiply weight of total three months' transfers by this labor cost per pound, arriving at labor cost for total three months' transfers.

12. Subtract labor cost of previous two months' transfers from labor cost of total three months' transfers, arriving at labor cost for current month's transfers.

13. Divide labor cost for current month's transfers by weight of current month's transfers to arrive at labor cost per pound of current month's transfers.

14. Subtract labor cost of three months' transfers from total labor cost (as per operation Number 2), arriving at inventory of labor in process.

15. By dividing inventory of labor in process by weight of inventory it should give 50% of the pound cost of total three months' transfers.

16. Divide total of Expense in Process, as arrived at in operation Number 2, by the total transfers plus 50% of Inventory (operation Number 9) to arrive at average expense cost per pound.

17. Multiply weight of total three months' transfers by this expense cost per pound, arriving at expense cost for total three months' transfers.

18. Subtract expense cost of previous two months' transfers from Expense cost of total three months' transfers, arriving at expense cost for current month's transfers.

19. Divide expense cost for current month's transfers by weight of current month's transfers to arrive at expense cost per pound of current month's transfers.

20. Subtract expense cost of three months' transfers from total expense cost (as per operation Number 2), arriving at inventory of expense in process.

21. By dividing inventory of Expense in Process by weight of inventory it should give 50% of the pound cost of total three months' transfers.

22. Add material, labor, and expense values of current month's transfers and extend in total value column.

23. Add total value of current month's transfers to total value of previous two months' transfers.

(a) Prove total arrived at by adding across the material, labor, and expense values of three months' transfers.

24. Subtract total value of three months' transfers from total value of three months' input plus inventory first of quarter (operation Number 2), arriving at total inventory value.

(a) Prove figure arrived at by adding across the material, labor, and expense values of inventory at end.

25. Add material, labor, and expense pound costs of current month's transfers and extend in total pound cost column.

(a) Prove figure by multiplying weight of current month's transfers by total cost per pound, which should give total value for current month's transfers.

26. Add material, labor, and expense pound costs for three months' transfers and extend in total pound cost column.

(a) Prove figure by multiplying weight of three months' transfers by total cost per pound, which should give total value for three months' transfers.

27. Add material, labor, and expense pound costs of inventory and extend in total pound cost column.

(a) Prove figure by multiplying weight of inventory by total cost per pound, which should give total value of inventory.

28. Other pound costs on cost sheet should be computed and proved across the same as for current and three months' transfers and inventory.

8. TAYLOR STAMPING WORKS—SUMMARIZING STANDARD AND ACTUAL COSTS

The Taylor Stamping Works operates a budgetary system, part of which is concerned with setting up estimates of the manufacturing costs for the ensuing year, it being the intention to compare the actual costs with the standards thus set up, for the purpose of discovering all variations from the estimates.

At the end of 1922 the cost records for the year give the totals shown on page 375, and it is desired to close the accounts in a manner to show the true profit or loss, including all variations from the estimated profit or loss. The chief cost accountant desires to show a closing which included both standards and actuals in the ledger, by means of double columns on each side. The comptroller, however, believes it to be sufficient to use only one column each for debit and credit, as usual, with one set of

figures only. For all outside transactions the actual figures will be used; but all internal transfers for costing purposes will be made at standard costs, the final inventories being taken at actual. The comptroller then proposes to compare standards and actuals by means of a statement drawn outside the ledger.

Show the ledger closing (a) according to the chief cost accountants' method, (b) according to the comptroller's method, with the statement referred to.

Account	Standard	Actual
Material Inventory, January 1, 1922	$ 27,500	$ 28,000
Purchases 1922	163,000	161,000
Issued to Process	164,000	161,800
Inventory December 31, 1922	26,500	27,200
Labor Costs during 1922	137,000	140,000
Burden Expense during 1922	105,500	109,000
Burden Charged to Production	92,000	96,500
Cost of Finished Goods Sent from Factory to Finished Stores:		
Material	160,000	158,000
Labor	132,000	134,000
Burden	93,000	97,000
Total	$385,000	$389,000
Work in Process Inventory, January 1, 1922	$ 85,000	$ 88,000
Work in Process Inventory, December 31, 1922	93,000	97,300
Finished Goods Inventory, January 1, 1922	46,000	45,500
Cost of Goods Sold during 1922	394,000	397,000
Inventory of Finished Goods December 31, 1922	37,000	37,500
Sales during 1922	472,000	479,000
Analysis of Cost of Sales:		
Material	164,000	161,000
Labor	135,000	137,000
Burden	95,000	99,000
	$394,000	$397,000

C. MACHINERY AND TOOLS

9. KINKAID MACHINERY COMPANY—ASSEMBLY COSTS

The Kinkaid Machinery Company manufactures machines for winding twine, rope, yarn, floss, and light wire. Fifty per cent of the value of the company's output is in special machines; the

other 50% is in 20 standard machines. All the special orders arise from the different needs of customers. The special requirements consist of attachments for winding material which had never before been wound by machinery, or for winding material in a distinctively shaped package. To meet these requirements, the attachments are generally designed by the customer's engineer and an engineer of the Kinkaid Machinery Company. Even for the special machines, however, it is possible to use standard beds, legs and heads.

Each winding unit is called a head, and a standard machine consists of from 1 to 12 heads. If a machine is to have 6 heads, the base is large enough to contain the 6 in one row. Usually on the 12 head machines there are 6 heads on one side and 6 on the other; one of the standard machines, however, has 12 heads with the winding cones on the same side. The machines are uniform in height.

No machines are manufactured for stock. The company makes parts for each of the 20 standard machines and stores them in a worked material storeroom. The company carries stores on a maximum and minimum basis. The minimum for each part is one month's requirements based on past experience, and the maximum four months' requirements. For example, if 200 machine screws for an "A" machine were one month's requirements, 600 would be manufactured when the balance in the bin reached 200. When a standard machine has been sold, the required parts for its assembly are requisitioned from the worked material storeroom and sent to the assembly department. If the machine is a special job, all standard parts which can be utilized are requisitioned, and at the same time orders are placed with the Planning and Production Departments to manufacture the special attachments required.

Manufacturing Processes. The Kinkaid Machinery Company manufactures all parts for its machines. It operates a large foundry and makes all its castings. Since the company manufactures parts for stock, there is no fixed order in the manufacturing processes of parts and complete machines. Some parts are started and completed in the same department while others travel through four or five departments, and sometimes are in the same department two or three times during the course of

their construction. It is unnecessary to describe the operations transpiring in the manufacture of each part, but a description is given of the production of the cam, a representative part, which passes through several departments.

The cam is an eccentric which revolves on the shaft controlling the winding. By means of a cam roller, which travels in a groove cut in the circumference of the cam, the length of the throw, or the depth of the wind, is controlled. When a production order [1] is issued for standard cams, or for a special cam, the cam is cast in the company's foundry. Making the mold consists of seven minor operations performed by a bench molder. The mold is made in a box flask, which is in two parts. The mold is packed tightly with loam and the cam pattern placed on top. Potting sand then is sprinkled over the loam and the cam pattern so that the two parts of the box flask will separate easily. After the cores are placed, the next operation is gating, which consists of making four runways for the melted iron. The mold is then closed and ready for the pouring. After the molds are filled and cooled, the castings are removed, cleaned in tumbling mills and sand blasts, and sent to the castings stores.

In one end of the foundry the company manufactures its own cores from a mixture of sand, gluten, and core oil. Patterns are filled, then removed, and the sand core baked from 1 to 48 hours.

The cam is taken from the castings stores to the cam-cutting department, which completes its manufacture. In the cam-cutting department the ends of the head are squared and the shaft hole drilled. The next operation is shaft reaming, which smooths the shaft hole and makes it the proper diameter. Two holes, called locating holes, are then drilled by the side of the shaft. The fourth process is broaching the keyway, which cuts a slot in the side of the shaft hole for the purpose of fitting a key to lock the cam to the cam shaft. The final operation consists of milling and grooving. First the edge of the castings is cut down smooth, and prepared for cutting the roll groove. The roll groove is cut in the circumference of the cam so that the cam roller will ride in it, and thereby determine the length of the throw by controlling the traverse guide back and forth. From

[1] The production orders are issued separately for the successive operations by a central planning department.

the milling and roll groove cutting machine, the cam is taken to the worked material storeroom, where it awaits requisition by the Assembly Department. All labor on the cam is on a piece basis.

Assembly. When an order comes in for a standard machine, the Planning Department requisitions the necessary parts, and they are sent to the Assembly Department. The final assembly is made by assembling seven parts which have been subassembled. The first operation of the final assembly is attaching beds and legs. The machine is placed on the floor, and the frames put on. Each head is contained in one frame, and is assembled later. Hence, there are from 1 to 12 frames on each machine. During this assembly, subassemblies are going on. The first is assembling the gainer frame, which consists of five parts, including cam shaft, two gears, a pinion, and a cover. The traverse frame is assembled from seven parts, and when the traverse frame and gainer frames have been assembled, they are placed on the machine, one of each in each frame. The traverse frame is that part of the machine which controls the guide feeding the material to be wound. It contains the cam roller which travels in the circumference of the cam. The next subassembly is the clutch, containing four parts. This part of the machine provides a means for the belt to run from its wheel to the gear on the gainer frame, which holds the cam shaft. The next assembly is the pulley which affords a means of transmitting the power from overhead to the machine. The spindle then is geared into the gainer and drives the package or the cone holder. The sixth subassembly is the tension bracket, through which the thread is fed, and the tension of the winding material is regulated. The tension bracket also takes out any knots or tangles from the thread as it is fed through, or if it is unable to do this, it stops the machinery. The final subassembly is the traverse frame counter weight. Its purpose is to provide the tension for the tension bracket. These parts are put on after the gainer frame and traverse frame have been mounted, and they complete the machine.

The completed machine is oiled and run from 10 to 24 hours on the floor, and inspected at various intervals.

If the machine is a special order, a man is sent with it to the

customer in order to install the special attachments. Labor in the assembly department is on a day basis.

Describe briefly, without much detail, how the Kinkaid Machinery Company will obtain proper assembly costs.

10. TERRY BATTERY SERVICE STATION— SYSTEM OF ACCOUNTS

Mr. George Eliot has recently purchased a local service station of the Terry Storage Battery Company. He is desirous of installing an accounting system which will be simple enough to be handled by one clerk, but will give all the cost information essential for proper control of the station's operations.

About half of the regular business done by the Terry Company is on new batteries. The other half of its income is received from service to users, 25% being received from charges made for labor and new parts put into repairs, 15% from recharging batteries, and 10% from batteries which are rented to owners while their own batteries are being repaired. In addition to these regular transactions, the sale of scrap material, especially scrap lead from batteries which are being repaired, and from old discarded equipment, is sometimes a substantial item. Records also must be kept for discounts taken and allowed.

The inventory consists of new batteries, battery parts and material, recovered material, which consists of old batteries bought from users or of portions of batteries which have gone out of service, and miscellaneous merchandise. The equipment consists of rental batteries, machinery, tools, shop equipment, office furniture, fixtures, and other equipment.

In addition to the service station manager, there are two office employees and two salesmen on straight salary who work outside the office promoting sales and looking after the interests of owners. Four floor salesmen, also on straight salary, sell new batteries and attend to the transactions with Terry owners who bring their batteries in for repairs or recharging. The service employees also include service floor men and stock men on the three classes of racks where batteries ready for delivery, held pending instructions, and rental batteries are kept. Repairs are made in the shop under one foreman.

Other costs include the ordinary charges for heat, light, power, and stationery, and also the costs of acid, gas, and oxygen, which are used in recharging and repairing batteries. It is estimated that the life of rental batteries is about two years. The customer is charged a fixed rate for the hours of direct labor spent on his battery, which is set at a point sufficient to cover the direct wages and an allowance for overhead. Interdepartment charges for repairs and recharging on rental batteries in the shop are made at 50% of the corresponding charges to customers.

What accounts should be set up to supply the desired information?

II. THE FEDERAL PUMPING MACHINERY COMPANY—STANDARD AND ACTUAL COSTS

The Federal Pumping Machinery Company manufactures a limited number of models of air compressor pumps, and has a complete system of cost accounting by which it arrives at detailed costs of its products. No attention is given to standard costs, however, and the company desires to investigate their efficacy for the purpose of affording more basic and reliable cost figures than are at present available. The present system may be described in outline as follows:

Material Costs. An effective system of stores control is in operation. Materials are purchased only upon proper purchase requisition from the cost accounting department, based upon a definite manufacturing program and carefully kept inventory cards. All materials received are entered upon these inventory cards, which also show the quantities allocated, quantities issued, and stock available, the latter being the difference between the quantity allocated and the quantity received. One of these cards is used for each different part kept in stock. Materials issued are charged into process and credited to the stores at the prices recorded on the inventory cards. In the event of varying prices the materials are charged out at prices following in order those at which they were charged into stores. Upon issue, the materials are charged to the parts cost cards in a manner to be described hereafter.

Supplies are similarly handled, being issued only upon written requisitions which indicate the destination and use of the

supplies called for. This furnishes the basis for a charge to the departmental expense account which will enter into the departmental overhead. Any materials commonly entered into the direct costs, which are used as supplies or as repair parts for equipment, will also be handled by a requisition which indicates the precise destination and use to which they will be put, thus enabling the proper account to be charged.

The machines put out by the Federal Pumping Machinery Company being pretty well standardized, most of the requisitions take the form of a bill of materials which calls for all the parts of a machine of standard specification. This bill of material indicates all the principal parts separately, and then covers all the minor parts—such as screws, bolts, nuts, and so on—in a general descriptive item. This enables the cards for the stores inventory to be kept accurately for all parts of any magnitude, and even the smaller parts can theoretically be recorded accurately, as it is assumed that the standard specification is adhered to every time, though of course there is a certain amount of wastage due to loss of small parts.

Labor. Complete time records are kept in triplicate for all operations, and for all time devoted to non-productive purposes. One copy goes to the payroll department, another is kept by the workman as his instructions, and a third goes to the cost department. The different copies are somewhat differently used, the first copy being made out one card for each day, so as to supply the payroll department with its daily time record. Of the third copy, however, only one card is made for each job, so that the daily record from the first copy needs to be posted to it in order to accumulate the labor costs of a job which runs for more than one day.

Upon receipt of the daily time cards, the payroll department enters the information upon the individual worker's card which, as the name indicates, accumulates for one week the total time and wages due to the individual workman whose name is on the card. The different classes of pay—such as piece wages, day wages, or overtime—are separately shown on this card. The actual payroll itself it merely a summary of the individual workers' cards.

Cost of Individual Parts. The general scheme of cost finding

is that the cost of every operation on every part is ascertained. By adding together the costs of all the operations on one part, the material cost of that part, and an amount for factory burden, as afterwards described, the total cost of the part is ascertained. The total cost of a complete machine then consists merely of the sum of the costs of the several parts contained in that machine, plus the labor and overhead costs of the assembling.

In order to carry out this plan, the cost records are made to fit into a card-index cabinet, which has primary divisions for the individual parts, and subdivisions for the operations on the parts. Generally speaking, the divisions containing the parts going into one machine are kept together, but it will be understood that in many cases the same part may be used on several different models, in which case there will be no duplication in the card record, where one section contains all information for that particular part.

The material requisition is of a size which fits into this card index, and one copy is accordingly dropped into the section for the part concerned. Next, the labor time cards which are made out separately for each operation are put into the card index, each under the operation it records. In front of the section containing cards for each operation is an operation cost card upon which the totals of the different jobs involving that operation are accumulated. This is done by taking the labor time cards which have accumulated during one month, totaling up the number of pieces which have gone through, the time which has been put upon them, and the cost of that time, and entering these monthly totals on the operation card, which contains one line for each month of the year.

In front of the entire section representing the record for one part is an individual parts cost card which summarizes the costs of the part for that month; one of these cards is made out for each month and lists the operation costs classified according to the departments in which the several operations take place. A space is also provided for the total labor of these operations by departments, to which is added a percentage to cover the burden of each department, the percentage being different for the different departments. It is then only necessary to add the material costs, as shown in the material requisition which is in

the file, to get at the total cost of one part as shown by the records of the month.

The general overhead is distributed to the departments on the basis of the total productive-hours of the several departments and of the whole factory, and the charge to individual jobs or operations is on the same basis, as shown by the addition of overhead to the labor costs of the several operations.

The Federal Pumping Machinery Company has now been advised that it would reap considerable advantage in the character of its cost information if it would revise the foregoing system for the purpose of showing standard or predetermined costs as well as actual costs. The following advantages are asserted in favor of the ascertainment of standard costs:

The elimination of temporary fluctuations from the cost information upon which pricing shall be determined.

A clear showing of all the variations between actual costs and the predetermined figures set up.

A more enlightened control is possible with this comparison available.

Greater facility and simplicity in the records, by the elimination of individual records on some elements of costs.

A more significant and basic cost is obtained.

The accounting staff of the Federal Pumping Machinery Company has therefore been giving attention to the meaning and the methods of operating a system of standard costs. In the course of their investigations they have considered the methods suggested by Garry,[1] by which an attempt is made to provide standard costs for an output consisting of a variety of

TABLE A[2]

SCHEDULE OF FACTORY COSTINGS

Class Average				Selling Price	Castings	Fittings	Wages	Prime Cost	Factory Charges	Factory Cost
£	s	d		£ s d						
11	15	0	A.E.D.	12 10 0	45/10	25/–	35/–	105/10	37/–	142/10
			A.T.F.	12 10 0	40/–	22/–	28/–	90/–	31/8	121/8
			A.F.F.	11 10 0	35/–	20/–	24/–	79/–	27/10	106/10
			A.N.O.	10 10 0	28/–	18/–	22/–	68/–	24/–	92/–

[1] Garry, H. Stanley, *Multiple Cost Accounts.*

[2] Ibid., p. 25.

machines, each of which is assembled out of many and various parts. Garry's system essentially consists of working out average or normal costs which are arranged in a schedule as shown in Table A on the preceding page.

These standard costs are converted into units, obtained by designating the total factory cost of one machine, namely, the A. E. D. as "1.000." Reduced to fractions of this unit the various costs of the several machines are shown in the second table as follows:

TABLE B [1]

	Factory Cost	Castings	Fittings	Wages	Established Charges	Castings and Fittings	Prime Cost
A. E. D.	1.000	.318	.176	.246	.260	.494	.740
A. T. F.	.852	.280	.154	.196	.222	.434	.630
A. F. F.	.748	.245	.140	.168	.195	.385	.553
A. N. O.	.644	.196	.126	.154	.168	.322	.476

Each machine is then subdivided into its several parts and a table is worked out showing the costs in material, labor, and burden, for each part of the machine, expressed in terms of the same unit. Subsequently, all the usual cost records are kept in these artificial units, in such manner as to show the actual costs and the standard costs for all parts of the product, in terms of the unit.

It is claimed that this comparison of standard and actual costs gives all the usual advantages of a standard cost system; and in addition, that the device of expressing all records in terms of the unit enables a composite product consisting of a great variety of items to be summarized into a single homogeneous total, expressed in terms of the standard unit. It is said that a manufacturer of many machines will thereby be enabled to reduce all the complexities of his product to a single item, in the same way as a coal mine operator is able to state all figures in terms of a ton of coal, and the cement manufacturer uses the barrel of cement.

The chief cost accountant of the Federal Pumping Machinery Company objects to this plan in so far as it requires the expression of all cost records in terms of the artificial unit. He emphasizes the labor of translating dollars and cents into this unit

[1] Ibid., p. 26.

and back again into ordinary currency; he contends that the author probably devised this method as a means of escaping from the difficulties of the sterling coinage system. A decimal coinage system will, he asserts, accomplish the same result without translation—any amount and any variety of product can be summarized into a single total of dollars and cents, provided that the component parts have been previously given a standard value in dollars and cents. He is further dissatisfied with the proposal to retain the standards for a long period of time in cases where current costs may have altered considerably.

One of his assistants draws attention to the plan practiced in some plants whereby a regular record is kept showing the ratios of current costs to the standard costs, by aid of which the latter may be converted into the former at any time when necessary.[1] The assistant claims that this device would enable the standards, once set up, to be retained for a long period in spite of considerable price changes, seeing that the necessary factors for correction would be available.

The chief cost accountant replies to this that the recording of the ratios of actual to standard costs, as a necessary part of the cost system, would be open to the same objections as the artificial units contained in Garry's system. His own idea is that standard costs should be set on the various items of product and their component parts, the standards to be based upon their most recent experience, modified by the best forecast obtainable for the immediate future. The standard costs should, in fact, be the figures used in compiling the production budget. He desires that the same standards shall remain in use through the entire fiscal year, if possible, but that they might be changed every six months if market conditions necessitated it. In other words, the standard costs should always be the best possible estimate as to what the actual costs are going to be, and should be kept in operation unchanged so long as the actual costs do not depart too far from the standards. He believes that they should not allow themselves to be too much influenced by the violent fluctuations of the war period, and yet that the whole system—both standards and actuals—should conform as closely as possible to current costs.

Assuming it to be decided that a system of standard costs

[1] *See* Harrison, *Cost Accounting to Aid Production*, pp. 84-87.

will be inaugurated in the plant of the Federal Pumping Machinery Company, describe briefly how you would proceed to set up the standards for the various elements in cost. What results you would expect to get from them? How long would you continue the standards unchanged?

What is your opinion of the several advantages claimed for standard or predetermined cost figures?

Is the system at present in use in the plant of the Federal Pumping Machinery Company entirely lacking in such information?

Could slight modifications of the system be made to give substantially the results claimed for standard costs?

Assuming that you recommend a thoroughgoing revision of the system, for the purpose of arriving at standard costs with the corresponding actuals, outline a system, together with the principal forms you would require, which would show the desired results.

How should the standards be fixed? One member of the staff proposes to use "normal" figures, meaning the average of several years covering a complete business cycle. Another member points out that a budget is compiled showing the anticipated figures for each year, and suggests using the budget figures as the standards for the year on which they apply. The works manager urges that the standards be fixed on the basis of their experience in the works of the accomplishment of reasonably good workmen, corrected for any new information they may have. In other words, the standards should be "something to aim at."

What are the advantages and disadvantages of each of these bases, and which do you recommend?

12. ANNAWAN ELECTRIC COMPANY— THE USE OF STANDARD COSTS

In 1919, a firm of industrial engineers installed a system of estimated or standard costs in the factory of the Annawan Electric Company. The system was in use during 1920 and 1921, but production was suspended in January, 1922, owing to the business depression. In August of the same year, when preparations for resuming quantity production were commenced, the General Manager, who had never been in sympathy with the

system, suggested that it should be replaced by a detailed cost system which would show the exact cost of each article produced.

The System of Standards

For six months after a new product is added to the line, detailed costs are kept of the material and labor necessary for its manufacture.[1] Repeated time-studies are made of each operation, whether on machine or bench work. At the end of the test period, a list of standard processes and materials is made up and entered in a standard practice book which contains similar data for the other products. From this book the cost department can learn the exact amount of time and material which is necessary for each part of the finished product, as set up for the standards. In December of each year a standard cost for each product is set up for use during the coming year. All standards are in terms of 100 articles.

Material Standards. Materials are priced in the standard costs at their market value in December, and are expressed in dollars and cents for each product or part thereof.

Direct Labor Standards. Labor is valued in the standards at the rate of wages in force in December and is expressed in dollars and cents for each product or part. Practically all direct labor is paid by piece-rates.

General Overhead includes only those indirect expenses which cannot be allocated to departments. It is distributed among departments in proportion to their actual direct labor charges for the period. It does not appear in the standards except as it is indirectly included in the departmental standard overhead.

Departmental Overhead Standards. Departmental overhead is expressed as a percentage of the direct labor of each department. The percentages for the various departments differ and are based on past experience.

Shipping and Selling Expense Standards are expressed for each product as a percentage of standard factory cost, and are based on past experience.

One of the fundamental features of the system is to absorb all fluctuations from the standard in the period in which they

[1] *See note,* page 388.

occur, and to charge them to the cost of the goods completed in that period.[1] For this reason, it is evident that an even flow of raw materials into process and a steady flow of completed goods out of process are essential, if unit costs for a given period are to be significant.

Method of Handling Expenditures. When direct materials are received and paid for, they are charged immediately into process by use of a double column in the voucher register. The first of these columns, headed "Standard," contains the value of the merchandise at the rate established in the preceding December. The second column, headed 'Supplementary," contains the difference between the standard and actual cost of the goods. If the actual cost is greater than the standard, the supplementary entry is in black ink, if it is less than the standard, the entry is in red ink. At the end of the four-week cost period these supplementary charges for material are segregated according to the product for which they are used, and the net balance in each case is added to the standard cost of producing the goods completed during the time.

Labor. Labor is handled in a manner similar to material. Double columns are used in a payroll distribution which covers four weeks. An amount for direct labor, sufficient to cover the labor cost of the product of the period, calculated at standard rates, is charged in the first column. Any difference, however, between that amount and actual expenditures for direct labor is placed in the supplementary column, which is analyzed according to the products, and the net amount is charged at the end of the period as a cost of the goods completed during that time. Charges for indirect labor, which also are collected for four-week periods, become a part of the departmental and general overhead.

Overhead. Expenditures for purchasing, handling, and storing materials are added to the material cost as a standard percentage of the value of material used. Variation from this figure is added to or deducted from cost of the material used.

[1] Daily reports of parts and product completed in each department are compiled by the production department into monthly summaries, which provide the basis for operation of the standard cost system.

General Factory Overhead. The total of these expenditures is arbitrarily divided among departments in amounts proportioned to the departmental direct labor for the period. The charge then becomes a part of departmental overhead.

Departmental Overhead consists of the following major items:

1. Fixed Charges
2. General Factory Overhead
3. Supplies
4. Indirect Labor
5. Power
6. Maintenance

Overhead is applied to the product in three instalments. First, the standard percentage of the standard direct labor in each department is charged; second, the standard percentage of the supplementary direct labor in each department is added; and third, any undistributed overhead is then added as a percentage of the total actual direct-labor cost in the department for the period. These cost operations must be performed for each product made.

Shipping. All expenditures in the shipping department are charged to the product completed during the period at the standard percentage of its standard factory cost. Any unabsorbed shipping cost is then added to product completed as a supplementary percentage of standard manufacturing cost.

Selling. Selling expense is handled in the same way as shipping expense.

Advantages Claimed for the System. The chief advantage claimed for the system is its saving of bookkeeping labor. As far as the cost department is concerned, the only current financial records necessary are the weekly payroll summaries, copies of invoices for material received, and a statement of the month's production. By carrying all inventories at standard value, the complicated records often involved in determining a satisfactory price at which to charge materials into process are avoided.

The Standard Cost System is best fitted for cases in which the products are few in number, and where raw materials flow into process, and finished goods out of process, at an even rate.

General Discussion

Weaknesses of the System Claimed by the General Manager

1. The system is based on the plan of charging material and labor into process when they are paid for, regardless of the time at which they are used. This arrangement is satisfactory only as long as production is distributed over the periods and products in normal proportions; if a small amount of one product should come from the factory during the period in which there are large supplementary purchases to be borne, the cost of that product for the period would be excessive and not true to fact. Or, if raw materials sufficient to last several months happen to be purchased within one month at a price above the standard, the goods completed within that month would have to bear the extra cost of material to be used during the succeeding months; thus the cost for the given month would be useless; a saving on material purchased would, of course, produce an opposite effect. Much of the labor, material, and overhead charged to the completed product is not expended upon that product; even though only the last operation is performed in a given period, the product is costed as if entirely made in that period. The cost attached to a product coming from the factory is in no sense, therefore, a true cost. A representative figure might be obtained by averaging these costs for several consecutive periods.

2. In the local books [1] material and labor charges lose their identity, as they are charged directly to the general work in process. It is thus impossible to ascertain, without taking a physical inventory, what portion of the process account consists of raw material stores.

3. Test runs, during which a product is carefully costed, are made only when the management believes cost conditions have changed appreciably. When the factory is busy, there is a tendency to neglect test runs.

4. When three or four products emanate from one department, very unfair cost distributions may occur. If, for example, trouble occurred in the grinding room in connection with polishing irons, which caused an extra heavy direct-labor cost in the department for the period, the irons would be charged only with direct labor at a standard rate sufficient to cover the operation under normal con-

[1] The general books of the company are kept at a central office.

ditions. This leaves a heavy supplementary labor charge to be borne by all the products using the department, in the proportion which the standard costs for the different products completed during the month bore to one another. This extra charge is therefore distributed on a basis which has no relation to the cause for which it was incurred. If, for example, there happened to be a smaller production than usual of the iron, the other articles would bear an even heavier portion of an expense for which they were not responsible. In addition, since departmental overhead would be added to the various products as a percentage of the inflated direct-labor cost, the undercharge to the product causing the trouble and the overcharge to the other products would be cumulative.

5. Shipping and selling charges are distributed to the product as a percentage of general factory cost of goods produced during the period. There is no immediate relation between goods sold and goods made. If shipments happen to be large and production small in a given month, the heavy shipping expenses applied to the light production will give excessive unit shipping costs.

6. One of the articles made, ranges,[1] is much larger and more costly to crate and pack than any of the other products, such as irons, yet there is no direct recognition of this fact in the method of loading shipping charges. Although a range costs much more than an iron, the output of irons is in thousands, whereas ranges are made in tens.

7. *Salvage.* Any material damaged in process is repaired by the regular workmen. This extra labor increases the supplementary labor charge of the department for the month. Salvage labor is shared by all the products, although all the salvage may

[1] The Annawan Electric Company manufactures five electric heating devices, namely, radiators, irons, grills, heating pads, and ranges. Each product is made in four or five styles or sizes.

Materials. Parts like iron bases and heater bowls are purchased for the most part in rough form. The Annawan Company finishes these parts, makes the heating coils and assembles the final product.

Labor. About 90% of the labor is on piece-rates. About half the work is at benches, the balance is on machines. The productive departments are as follows: Machine shop, grinding, buffing, painting, plating, sheet metal, and assembly rooms (for ranges, irons, pads, and general bench). Service departments are stores, tool making and experiments, shipping, maintenance, and inspection.

have been on one article. Inasmuch as the damaged parts are often accumulated for two or three months and then put through in a group, all costs for that month would be increased.

Goods damaged beyond repair are credited out of process at the standard cost for their materials and operations to the point of spoilage. The overhead which should be applied to them must, of course, be absorbed by the completed product.

8. *Storage Expense.* Purchasing and stores expense are added as a percentage of the value of material used during the period. Inasmuch as this expense is incurred on a basis of volume and bulk, the general manager objects to distribution on a basis of value. These expenses are furthermore affected by material purchased and received, whereas, the expense is distributed on a basis of material used.

9. *Idleness.* Idle time is automatically absorbed as supplementary overhead. When supplementary charges exceed twice the standard overhead, because of an idle plant or for any other reason, the excess is charged to an account called "Idle Plant," set up for the purpose.

10. *Manager's Statement.* A sample cost statement to the manager is reproduced on page 394. The total variation from standard, $669, in this case, is the significant figure on the statement, yet that amount is meaningless unless reproduced in conjunction with corresponding figures for preceding months. Similarly, the statement of Profit and Loss (page 396) has no meaning unless the manager is familiar with the structure of the system.

STANDARD COSTS FOR IRONS AS SET UP FOR YEAR 1920
All Figures for 100 Articles

Cost by Departments

Department	Labor	Percentage of Overhead	Overhead
Machinery	$ 5.00	170%	$ 8.50
Plating	25.00	160%	40.00
Assembling	10.00	80%	8.00
	$40.00		$56.50

TOTAL COST (STANDARD) PER 100 ARTICLES

Material	$100.00	
Stores Expenses	10.00	
Labor	40.00	
Overhead	56.50	
Factory Cost		$206.50
Shipping 1½% Standard Factory Cost		3.10
Selling 30% Standard Factory Cost		61.95
		$271.55

PAYROLL SUMMARY—PERIOD

Department	Actual	Standard	Supplementary	Percentage
Machining	$1,140	$1,200	$— 60.00	— 5%
Plating	3,850	3,500	+350.00	+10%
Assembly	1,274	1,300	— 26.00	— 2%

ACTUAL PURCHASES OF DIRECT MATERIAL FOR PERIOD

Material for Irons	Actual Price Paid	Standard Value Material Rec'd	Supplementary	Product Made	Supplementary per 100 Articles Made
	$12,700	$13,000	$—300	10,000 pieces	$—3.00

ACTUAL OVERHEAD FOR PERIOD

	Machining Department	Plating Department	Assembly Department
Total Overhead	$3,220	$7,830	$1,848
Direct Labor	1,840	4,350	2,174
Percentage of Overhead to Labor	175%	180%	85%
Percentage of Supplementary Overhead	+5%	+20%	+5%

ACTUAL STORES EXPENSE FOR PERIOD

Total Stores and Purchasing Expense	$ 5,064
Total Standard Value Material Used	63,300
Percentage of Expense to Value	8%
Standard Percentage	10%
Percentage of Variation	—2%

SHIPPING AND SELLING EXPENSE—PERIOD

Total Shipping Expense	$ 1,237	Total Selling Expense	$31,389
Standard Factory Cost of All Goods Sold	95,118		95,118
Percentage of Expense to Value	1.3%		33%
Standard Percentage	1.5%		30%
Percentage of Supplementary	.2%		+3%

FINAL COST SUMMARY—IRONS

Item	Per 100 Irons	Totals for Profit and Loss	Totals for Inventory
		Production 10,000 articles	
Material	100.00		$10,000
Supplementary Material	—3.00	$—300	
Stores	10.00		1,000
Supplementary Stores	—2.00	$—200	
Labor	40.00		4,000
Supplementary Labor	+2.05	+205	
Overhead	56.50		5,650
Supplementary Overhead	+3.41	+341	
Supplementary Overhead	+6.23	+623	
Salvage-Material Loss			
	213.19	$+669	$20,650
		Sales 4,000 Articles	
Shipping	3.10		
Supplementary Shipping	—.41	$— 16.40	
Selling Expense	61.95		
Supplementary Selling	+6.20	+248.00	
	$284.03	$+231.60	

Labor and Overhead Cost Summary—Irons

All Figures per 100 Irons

Department	Labor				Overhead					
	Standard	Supplementary		Net Labor	Standard	Supplementary				Net Overhead
		Per Cent	Amount			Due to Labor Variations		Due to Overhead Variation		
						Per Cent	Amount	Per Cent	Amount	
Machine	$ 5.00	−5	$−0.25	$ 4.75	$ 8.50	170	$−0.43	+5	$+0.24	$ 8.31
Plating	25.00	+10	+2.50	27.50	40.00	160	+4.00	+20	+5.50	49.50
Assembling	10.00	−2	−0.20	9.80	8.00	80	−0.16	+5	+0.49	8.33

In Overhead Calculations, the supplement due to Labor Variations is a percentage of the amount of Supplementary Labor; the Overhead Variation is a percentage of the Net Labor.

CONDENSED OPERATING STATEMENT ON IRONS
Actual Figures

Sales	4,000 @ $ 3.20		$12,800.00
Standard Factory Cost	4,000 @ $206.50 per 100		8,260.00
Gross Profit over Standard Factory Cost			$ 4,540.00
Standard Shipping and Selling Expense			2,602.00
Net Profit on Standard Cost			$ 1,938.00
Supplementary Manufacturing Accounts		$669	
Supplementary Selling Accounts		231.60	
		$900.60	—900.60
Final Net Profit			$1,037.40

13. ATLANTIC COAST SHIPBUILDERS ASSOCIATION—"JOB ORDER METHOD" OF COST FINDING

In the spring of 1919 the Committee on Uniform Methods of Cost Accounting of the Atlantic Coast Shipbuilders Association drew up a report and recommendations on uniform methods of cost accounting in shipbuilding. Among the advantages and reasons given by the committee for the use of uniform cost finding methods were the following:

1. They will show the complete cost of specific articles and be indicators of profitable and unprofitable production.
2. Uniform terminology will be established enabling comparison of processes and efficiency of production between units of shipyards and between groups of shipyards.

In order to attain these two ends the recommendations of the committee included the following outline of the "job order method" as applied to the shipbuilding industry.

Section 7

General Methods of Cost Keeping. Broadly considered, there are two general methods of ascertaining and compiling costs. One of these is generally referred to as the "process method" and consists of the gathering and compiling of costs by processes. The cost of any product unit or article is equal to the total of the direct and indirect costs and expenses incurred in the processes through which the product passed. The "process method" of cost accounting is particularly applicable where the product is standardized and production consists of a series of definitely measured complete processes or operations.

The other general cost finding method is that referred to as the "job order method." Where this method is used, cost charges are ascertained and applied against specific product, units, or jobs. The "job order method" is applicable where the product is not standardized, where the work varies considerably with different orders, or where the production does not consist of a series of standard recurring processes.

Of the two general methods, the "job order method" is clearly the standard method which can best be applied to the various activities in the shipbuilding industry. In a general way the "job order method" is the one which is at present in use in most of the shipyards, although there are many variations from the standard methods recommended.

The proposed uniform methods of cost finding for shipbuilding are briefly summarized as follows:

1. Costs are ascertained and compiled for every type and class of work which is done in a shipyard through the several series of production orders, as shown in Section 8 "Production Orders—Classification and Methods."

2. Costs are obtained and compiled for each of the product units through the different job accounts, as shown in Section 9—"Ship Product Units—Classification and Methods." Thus the cost of a production order is the sum of the cost of the product units.

3. The cost of each product unit is ascertained and compiled under the three main elements of cost, namely: direct labor and direct material charged directly to the product unit, and expense apportioned to it. The methods applying to and the classification of each of these elements are shown in Sections 11, 12, and 13.

4. For purposes of compiling and proving direct charge and uniform expense cost to production and securing control over all costs, definite departmental divisions and designations are used as shown in Section 10, "Ship Works Departments—Classification and Methods."

5. Costs are treated with definiteness and uniformity through standard classifications of the controlling divisions.

6. Definite cost figures under each of the job accounts or product units supply standards for use in estimating and measuring production progress and operating efficiency.

7. Control of all work in process and stores through the general ledgers.

Section 8

Production Orders—Classification and Methods

Purpose, Use and Basis of Classification. In addition to ship production work in a shipyard, there are a number of other activities upon which costs must be ascertained separately. The classification of production orders includes all the distinct shipyard activities, and distinguishing series of order numbers constitute the method of identifying these different classes of work.

Each order authorizing work is given a production order number by which that job is thereafter known and distinguished from all other orders. The production or job order numbers will facilitate in comparing all the elements of costs, in tracing the costs which are applicable to any job or contract, and in classifying the production work done in the shipyard.

The main series of shipyard production orders is set forth below and should be applicable to any shipyard. This series may be amplified or reduced without affecting the general plan. Whenever a block of numbers is used up a new block of numbers can be assigned.

Production Order Classification and Definitions. Following is the classification of the main classes of production orders and the definitions of each class:

1- 999—Construction Orders—Ships
1000-1999—Construction Orders—Ship Product Stock
2000-2999—Construction Orders—Special Contracts
3000-3999—Auxiliary and Stock Manufacture Orders
4000-4999—Defective Work Orders
5000-5999—Vessel Repair Orders
6000-6999—Construction and Betterment Orders—Plant and Equipment
7000-7999—Repairs and Maintenance Orders—Plant and Equipment
8000-8999—Miscellaneous Orders

1. *Construction Orders—Ships*—will be used on all orders for the production of a ship entire, including the steel, hull, machinery, and finishing and outfit.

2. *Construction Orders—Ship Product Stock*—will be used for all orders for the production of ship materials, parts or equipment (other than in auxiliary and stock manufacture departments) where the product is to go into stock.

3. *Construction Orders—Special Contracts*—will be used for all special orders of ship production where other parts of the entire ship or all work of special ship construction are included.

4. *Auxiliary and Stock Manufacture Orders* will be used for all orders for work by auxiliary and stock manufacture departments.

5. *Defective Work Orders* will be used for all orders in connection with defective work or for correction of defects in any article or product manufactured.

6. *Vessel Repair Orders* will be used for all orders for ship repair work.

7. *Construction and Betterment Orders—Plant and Equipment*—will be used for all orders for new construction or betterments on plant or

equipment, which improvements are permanent in nature and add to the capital investment of the plant.

8. *Repairs and Maintenance Orders—Plant and Equipment*—will be used for all orders on general repair and maintenance work on buildings, machinery, equipment, fixtures, or tools, which work does not affect the capital investment of the plant, the cost of which work is either charged to depreciation reserve, or is a part of productive general works or general administrative expenses.

9. *Miscellaneous Orders* will be used for all production orders not included in any of the above.

Symbol Codes. In the preparation of the different classifications, symbol codes have been set up which will be used to designate the respective items wherever they are used in the making of reports, and so on. The use of symbols reduces the amount of writing necessary in making out labor reports, material requisitions, and the like. Such codes or symbols will also lend themselves readily to mechanical sorting and tabulation, which mechanical devices are already being used in many of the shipyards for purposes of gathering and compiling payrolls, labor cost distribution, and material control.

The decimal system of symbols which has been used in the classifications which follow, consists of applying numbers to units of the classification, the main divisions of the classification being assigned the left-hand digit of a number, and the subdivisions being assigned digits to the right, and total digits making up the complete symbol code for any item or account.

For example: In the ship product unit classification the symbol for the main division "Manufacture of Ship Parts" would be 1; the subclassification of this main division, namely, "Structural Hull Manufacture" would be 11; the subclassification of this subclassification, namely, "Structural Hull—Steel and Iron" 111; and so forth. This numeral, 111, is a symbol for the Structural Hull—Steel and Iron Group, of the Structural Hull Manufacture Section, of the Manufacture of Ship Parts Division.

In making out time cards, material requisitions, shop orders, and so forth, it will be necessary to use in connection with the job account number, the production or job order number, the department number or machine number, and the plant symbol, where there is more than one plant belonging to one company.

Section 9

Ship Product Units—Classifications and Methods

Relation of Product Units to Production Order Classification. Under each class of production orders there are the product units upon which complete costs should be gathered, and to which charges should be made for material, labor, and expense costs. It is thus seen that the cost for any particular production order is the sum of its product units.

There are now considered the product units applicable to each class of orders:

Steel Ship Product Units. The steel ship product units constitute the product units which are applicable to all of the divisions of ship construction and repair. The same product units which are provided for orders on construction of ships are also applicable to ship product stock orders; construction orders for special contracts; defective work orders; and vessel repair orders.

Auxiliary and Stock Manufacture Product Units. The product units which are applicable to production in the Auxiliary and Stock Manufacture Departments are the products of the respective auxiliary and stock manufacture departments.

Construction and Maintenance Product Units. The product units which are applicable to construction and betterment orders on buildings, machinery, and equipment and repairs and maintenance orders on buildings, machinery, and equipment, are the buildings, and so forth, which are included under the different fixed assets, as shown in the classification of fixed assets.

Miscellaneous Orders Product Units. The product units applicable to miscellaneous orders will depend upon the character of the particular order. Whenever possible, the classification of product units used for the other production order series should be used for miscellaneous orders.

Steel Ship Product Units

(Applicable to Construction Orders—Ship; Construction Orders—Ship Product Stock; Construction Orders—Special Contracts; Vessel Repair Orders; and Defective Work Orders.)

The classification of steel ship product units contains the controlling accountings to which all charges in connection with material, labor, and expense costs will be made.

Charges are made for material against the steel ship product units based upon the classes of material which appear in the material classification. The quantity and cost of each class of material entering into each steel ship product unit can thereby be ascertained.

Charges are made for labor against each steel ship product unit based upon the labor operations appearing in the labor classification. The labor-hours and costs for each of the more important labor operations for each steel ship product unit can thereby be ascertained.

Proper percentages of expense are charged to each steel ship product unit based upon the expense items appearing under the expense classification. Part of these expenses are departmental and part are non-departmental, and such expenses are applied to the product units on the definite basis described in Section 6—"Principles and Specific Definitions—Expense."

As indicated in the first part of this report, a clear distinction is

made in the classification of ship product accounts, between the division of manufacture of ship parts, and the division of ship construction and engine and outfit installation. This makes it possible to ascertain separately the costs of manufacturing ship parts, and the cost of assembling, erecting, and installing parts and outfit into the vessel.

Basis of Divisions. Under each of these two principal divisions are included three main subdivisions as follows:

1—Structural Hull; 2—Engine; 3—Hull Finishing and Outfit.

In addition to these main subdivisions there is included, under the main division of ship construction and engine and outfit installation, a group of accounts which cover the direct charges which are of general character. These are hereafter referred to as Direct General Charges.

The ship product units classification can be carried out to as fine a point of detail as may be desired in any individual shipyard, provided that the unity of the controlling accounts is not disturbed.

Principal Divisions of Classification. The principal divisions of the ship product units recommended are as follows:

1. *Manufacture of Ship Parts*
   - 11. Structural Hull Manufacture
   - 13. Engine Manufacture
   - 15. Hull Finishing and Outfit Manufacture
   - 17. Auxiliary and Stock Manufacture

2. *Ship Construction and Engine and Outfit Installation*
   - 21. Structural Hull Erection and Construction
   - 23. Engine Installation
   - 25. Hull Finishing and Outfit
   - 27. Direct General Charges

The term *Structural Hull* consists of the frame or body of a vessel, exclusive of engines, outfits, and finishing, defined in what follows:

The term *Structural Hull Manufacture* includes all work and operations involved in the fabrication or machining or other work tending to put raw materials or component parts into a state where such parts are ready for ship construction. This section does not include the work and operations involved in the manufacture of auxiliary and stock products.

The term *Engine Manufacture* includes the work and operations involved in the manufacture of raw materials or such component parts which become a part of engines, turbines, machinery, pipes, and other parts for use in the complete installation of all engines, turbines, and machinery entering into the hull proper. It also includes the assembly of the parts of an engine into a completed engine.

The term *Hull Finishing and Outfit Manufacture* includes all work

and operations involved in the manufacture of raw materials and parts into a state where such items are ready for vessel use and installation, as indicated under the subdivision of Hull Finishing and Outfit Manufacture.

The term *Structural Hull Erection and Construction* includes all work and operations involved in the erection and construction of the structural hull of a vessel.

The term *Engine Installation* includes the work of installing and fitting all engines and machinery items into a vessel.

The term *Hull Finishing and Outfit* includes the work of fitting out, finishing, and outfitting the vessel with the parts and articles indicated under the subdivision of Hull Finishing and Outfit.

The term *Direct General Charges* includes the charges which are general in character and which can be applied directly against a ship contract, but are not allocable to any one of the other main divisions.

Special Notes on Classification. The main divisions of the ship product units classification include the divisions and items which are applicable to ordinary merchant ships. In those cases where special designs are required, as for naval ships, additional job accounts can be set up without affecting the general plan.

Where it is desired to ascertain and apply costs to subsidiary divisions or units, the divisions under the controlling job accounts can be carried out according to the following plan:

I. *Division* II. *Section* III. *Group* IV. *Part*

Each of the main divisions consists of sections indicating character of class of job. Each section consists of groups indicating arbitrary divisions of a hull and structural parts or types of engines, machinery, outfit, and so forth. Each group in turn consists of a number of similar pieces or parts, which, when assembled with other parts, make the group or product unit.

Where such records are desired, the part or piece mark will, therefore, consist of a division number, a section number, a group number, and a part number. In addition, each of the parts or pieces will be given a serial number according to sequence and use.

The job accounts as given in the main classification, or such subsidiary divisions as may be desired, will be the basis of the outlines for cost summaries and cost estimates on production, as well as the basis for payment for work completed.

It is contemplated in the above that expenditures for engineering and drawing work will, wherever it is feasible, be made direct to the job account or product unit. To do this it will be necessary to apportion the engineering and drawing expense chargeable against a particular contract among the various job accounts.

Detailed Product Unit Classification. The following is the suggested classification of main ship product units:

I. *Manufacture of Ship Parts*

II. *Structural Hull Manufacture*

111. Structural Hull—Steel and Iron
112. Structural Castings and Forgings
113. Scrap in Steel Hull Manufacture

Each of the above groups may be divided into units indicating individual parts or pieces of structural steel materials going into the steel hull.

Auxiliary and Stock Manufacturing Product Units. Related to the steel ship product units are the products manufactured by auxiliary and stock manufacturing departments, the cost of which cannot be charged directly against ship construction and production.

The operations of the iron foundry, the brass foundry, the paint factory, and such other auxiliary and stock manufacturing departments, should be accounted for separately from the operations of the other production departments. Separate accounts should be maintained of the cost of direct and indirect labor, materials, fuel, and other supplies, as well as all expense of any kind connected with and occasioned incidental to such production. The products of these departments will be invoiced to stores in a manner identical to the treatment given to materials purchased from the outside.

For the auxiliary and stock manufacture products, the costs should disclose the cost per unit, where the product is of the same general type. In those cases where the product varies the cost per job should be the figure used.

No attempt will be made here to provide systems of cost keeping for all auxiliaries which may exist in the shipyards. The principles and general methods proposed for ship production will apply with equal force to the auxiliary production departments. The one thing which should characterize all methods is that they should disclose the unit costs whatever the unit is, and that they should represent the whole cost. The article produced is the product unit and to it all charges of labor, material, and pro rata share of all expenses should be made.

Other Auxiliary and Stock Products. For each of the stock manufacturing departments it will be necessary to have individual product units for collecting and analyzing costs. The methods should follow the general outline for ship production cost; charging labor and material direct, departmentalizing the production department expense, and treating other expenses as discussed for ship production.

Construction and Maintenance Product Units. The job account or product unit which should be used in connection with plant construction and maintenance, is that of the individual items shown in the classification of fixed assets. The purpose of this is to show the total cost of construction, betterments or repair jobs on buildings, equipment, or machinery.

The classification of fixed assets should follow the main heads.

1. Land and Structures
2. Power Machinery
3. Shop Machinery and Tools
4. Cranes, Elevators, and so forth
5. Furnaces and Forges
6. Other Equipment
7. Furniture and Fixtures
8. Patents and Royalties

Miscellaneous Orders Product Units. Whenever an order is placed which falls under the series of Miscellaneous Orders, it should be analyzed into product units similar to those appearing under the Ship Construction Product Unit Classification. To each unit all material and labor should be charged directly, and the expense apportioned upon the basis recommended in other cases.

Section 10

Ship Works Departments—Classification and Methods

Relation of Departmental Classification to Product Units, Labor and Expense. It has been shown how the departmental classification is subsidiary to the ship product unit classification. Charges are made to the job account or product unit for labor, material and expense. The direct labor charges against the job accounts are reported through the departments, and labor charges thus secured are used as the basis for distribution of expense to the various job accounts or product units.

The departmental classification has its greatest use in connection with distributing and applying expense costs to the product units or job accounts. In so far as it is possible, all expense charges should be assigned to departments for accuracy in expense distribution, and as a means of operation control.

Basis of Departmental Classification. The departmental classification includes the typical departmental divisions which are ordinarily found in a shipbuilding organization. The divisions and titles of departments will vary in different shipyards, but the general layout should be applicable to any shipbuilding company.

In those cases where there are more than one ship works, each plant will be given a separate plant number or other distinctive code designation, and this designation will be used with the departmental code designation for reporting and ascertaining costs and for proper expense distribution. In those yards where certain activities are not carried on, or where departments are under different jurisdictions, changes can be made in the classification without affecting the general classification plan and the main divisions.

The main divisions of the departmental classification are as follows:

1. Productive Departments
2. General Works Departments

3. General Works Distributive Departments
4. Auxiliary and Stock Manufacturing Departments
5. General Administrative Departments

Definitions of Main Divisions

1. The *Productive Departments* include those departments of a plant which do the actual work in producing parts and articles for ship construction, or in erection, assembling, or installation of parts in ship construction or vessel repair work.

2. The *General Works Departments* include those non-productive departments which are identified with a particular plant, except those departments included under the classifications which follow.

3. The *General Works Distributive Departments* include those departments which furnish services which are measurable, and in which the expense of operation can be charged directly to productive and other departments upon the basis of the amount of service rendered.

4. The *Auxiliary and Stock Manufacturing Departments* include those departments which produce articles and materials which cannot be charged directly against ship construction. The products of these departments are invoiced to stores in the same manner as are the materials purchased.

5. The *General Administrative Departments* include those departments which have to do with the general administration of the company's affairs.

Notes on Departmental Classification. In those shipbuilding companies having more than one works or shipyard, the administrative departments at each plant should, for organization purposes, be considered as branches of the central departments. Where administrative departments in a plant have such functions as place them under the jurisdiction of central departments, the former departments should have the same titles and code designations as the latter, with proper plant designations to distinguish the departments for each plant.

The distinction which is made in this classification between the general administrative departments and general works departments, is clear in a shipbuilding company having more than one works. In those shipbuilding companies having but a single works, where the general administrative departments are not distinct from the general works departments, it is suggested that the various administrative departments be considered as works departments, except the following which should be considered as general administrative departments in any case:

501—President—Office and general
502—Vice-President—Office and general
503—General Manager—Office and general
504—Legal Department
505—Treasury Department

518—Sales Department
519—Branch Offices

Section 11

Materials and Supplies—Classification and Methods

Purposes and Use of Classification. Costs must be classified according to the different elements of costs as well as according to the product units and departments. The main items falling under the element of material costs have been set up under the classification of materials and supplies. This classification includes the main material and supply divisions, which will be used by the engineering or production department; by the purchasing, stores and traffic departments; and by the accounting department in connection with the preparation of bills of material, purchasing, receiving, storing, issuing, pricing, inventorying, and assembling of material costs, and will serve as the basis for analyzing materials which are in work in process.

The keeping of the material cost records will be of value in connection with the following:

(a) Basis for estimating and for preparing bills of material
(b) Basis for comparing quantities of particular items going into specific product units with standards
(c) Making sure that all materials entering into a product have been accurately charged
(d) Computing and analyzing material charges
(e) Ascertaining the degree of completion on any job
(f) Checking waste or excess amounts of any particular material entering into a product unit

Under the contract stores are included materials, parts and equipment which are purchased, manufactured or taken from general stores for a specific job or product unit. Charges for such contract materials should be made direct to the contract or job from invoice when purchased specially for any job. In the other cases, charges are made when the stores are received in the contract stores. The account charged is the product unit for which the material will eventually be requisitioned. When the material is requisitioned out of contract stores, it will not be charged to the product unit, but record will be made of the issue. In case material which is charged against a specific product unit is used on another product unit of the same job order or on a product unit of another job order, a charge should be made against the product unit which used the material, and a credit made to the other product unit.

For adequate material control and for accuracy in the handling and charging of materials, it is essential that perpetual inventories should be maintained for all stores. These inventories should at all times show the balance on hand, the amounts ordered and average costs. No material should be issued from stock except upon written requisition.

Section 12

Labor—Classification and Methods

Purposes and Uses of Classification. For the purposes of payroll preparation and distribution of labor costs, definite classifications and definitions of the different classes of labor and of the major labor operations are necessary.

The classification of positions and occupations under main groups according to the character of work and under distinctive occupational titles, should be used as a basis for the preparation of payrolls and of statistics on wage changes, selection, labor turnover, accidents, and other employment conditions.

The basic units for labor costs in shipbuilding are the labor processes or operations. The distribution of labor costs according to the major labor operations will be used for purposes of cost control, estimating, comparing costs with standards, and gaging the efficiency of classes of workers in the productive departments, on the various jobs, and for the plant as a whole.

Basis and Definition of Main Labor Classes. The labor classification which appears below is drawn up on the basis of general character of work. Under each class there are included the different positions and occupations which are found in the average shipyard.

The main classes of the classification are as follows:

1. Executive, Administrative and Supervisory Class
2. Professional Class
3. Clerical Class
4. Supervising Producing Class
5. Skilled Trades Class
6. General Labor and Miscellaneous Class

The following definitions of the main classes will serve as a guide for the classification of occupations and positions:

1. *Executive, Administrative and Supervisory Class* includes those positions in which incumbents assume primary responsibility for the direction, supervision, and control of the activities or work under their jurisdiction (except such positions as are specifically included in Class 4, the Supervising Producing Class).

2. *Professional Class* includes those positions in which incumbents perform work requiring training or experience in a recognized profession. (Executive and managing positions having direction of professional work should be included in the Executive, Administrative and Supervisory Class.)

3. *Clerical Class* includes those positions in which incumbents perform clerical work or service in connection with routine administrative office work or related duties. (Executive and managing positions having general charge of such work should be included in the Executive, Administrative and Supervisory Class.)

4. *Supervising Producing Class* includes the positions of Quartermen, Leading men or Gang Leaders, and positions having similar supervising duties.

5. *Skilled Trades Class* includes those positions in which incumbents perform work in the different trades, handicrafts, or useful arts, or work requiring manual or mechanical skill and experience. Positions having duties of the inspection of materials, of workmanship, or of special conditions should also be included under this class.

6. *General Labor and Miscellaneous Class* includes those positions in which incumbents perform routine, unskilled manual labor. This class should also include miscellaneous positions not covered in any of the above classes.

Classification of Major Labor Operations. The following classification of the basic units of labor costs includes the more important production labor operations. Charges of direct labor costs should be made to the job account or product unit according to the labor operations. The operation symbols will be used with the productive departmental designations for labor distribution to the job accounts or product units.

Where specific labor operations are not included in the following classification, the direct-labor hours and costs of miscellaneous workers should be included under the miscellaneous operations group or under the distinctive operation symbols as may be deemed necessary.

Following is a list of some of the important productive labor operations and code symbols:

1. Annealing, Hardening, and Tempering
2. Assembling
3. Bench, Vise, and Floor Work
4. Bending and Flanging
5. Blacksmith Work
6. Bolting
7. Boring Mills Work
8. Chipping and Caulking
9. Coremaking (Foundry)
10. Drilling
11. Engine Lathes
12. Erecting
13. Fabricating
14. Finishing
15. Fitting
16. Furnace Work
17. Grinding and Buffing
18. Handling Steel
19. Laying Out and Templating
20. Melting (Foundry)
21. Miscellaneous Operations

22. Molding (Foundry)
23. Painting
24. Planing
25. Punching and Shearing
26. Reaming and Countersinking
27. Riveting—Machine
28. Riveting—Hand
29. Rolling
30. Sawing
31. Scarfing
32. Stamping (Sheet Metal)
33. Testing and Inspecting
34. Turning and Winding
35. Varnishing and Polishing
36. Welding

Timekeeping and Cost Distribution. The value of accurate methods of reporting and recording the daily time of each employee for payroll making and for proper distribution of labor hours and costs against production cannot be stressed too greatly. For accurate payroll making, for proper control of labor in production and for estimating and comparative purposes, it is necessary to have proper timekeeping methods, the essentials of which are as follows:

(a) Proper method of recording the daily time of each employee. There should be time clocks on which each worker should register in and out time, or there should be some other method of obtaining the same results.

(b) Job or operation tickets should be turned in by each worker for the various operations performed each day. On these job tickets there should be recorded the worker's number, the production order number, the product unit number, and the time taken on each operation.

Where mechanical sorting and tabulating equipment is available, the tabulating card and the job ticket can be one and the same, the requisition information being noted on the card in writing and the punching of the cards being done later in the timekeeping office.

(c) The total time and cost, as found from the daily in and out cards, as explained in paragraph (a) should check with the total time and cost of all the operations on job tickets. This check should be obtained daily by departments.

(d) The job tickets should be sorted by trades to obtain the actual hours, the number of hours converted into eight-hour days, the total pay received and the pay per eight-hour day. The total pay in this case should check with the totals under paragraph (a) and paragraph (b).

(e) Job tickets should be sorted in order to obtain hours and pay on piece-work, on day-work, on overtime, on direct labor, on indirect

labor, and on all of these by departments. The total pay in each case should check with totals obtained above.

(f) Job tickets should be sorted by labor operations and by job account or product unit numbers for posting to the cost summary sheets.

It will be noted from the amount of sorting and tabulating required that the use of tabulating and sorting machinery will be of considerable value.

Section 13

Expense—Classification and Methods

Purpose and Use of Classification. The costs of direct labor and direct material entering into production are applied directly to the job account or product unit. The costs of indirect labor and indirect material and other operating and fixed charge expense, which cannot be applied directly to the specific job account or product, are included under "expense."

To obtain accurate and uniform distribution of expense to the job accounts, the expense items are grouped under specific classes and expense accounts as given in the classification of expense. The expenses are applied to the job accounts or product units after they have been distributed to the specific departments. The basis and methods suggested for expense distribution to departments and expense application to the job accounts or product units are included under Section 6—"Principles and Specific Definitions—Expense."

Basis of Expense Classification. To accomplish the purposes set out above, all expense charges which fall under specific departmental groups have been included under departmental expense divisions. Those expense charges which are not departmental in their nature are included under non-departmental expense divisions.

The principal divisions and subdivisions in the expense classification consist of the following:

1. Productive Departmental Expense
2. General Works Expense
   - (a) Departmental
   - (b) Non-departmental
3. General Works Distributive Expense
4. Auxiliary and Stock Manufacture Expense
5. General Administrative Expense
   - (a) Departmental
   - (b) Non-departmental
6. Fixed Charge Expense

Under each of these divisions are included specific expense accounts to which all expense charges should be made directly.

The divisions and subdivisions of the expense classification have been so arranged that they will be applicable to any shipyard, and any changes in specific expense accounts can be made without affecting the main divisions.

DEFINITIONS OF PRINCIPAL EXPENSE DIVISIONS

1. *Productive Departmental Expense* includes the indirect charges of the respective productive departments. Distribution of productive department expense to job accounts or product units is discussed under Section 6—"Principles and Specific Definitions—Expense."

2. *General Works Expense* includes the indirect expenses chargeable to production costs which cannot be charged directly to some definite productive department, and which cannot be applied to one of the other classes of expenses in the classifications which follow.

3. *General Works Distributive Expense* includes all expenses directly attributable to the operation of the general works distributive departments.

4. *Auxiliary and Stock Manufacturing Expense* includes all expenses incurred in the operation of an auxiliary and stock manufacture department.

5. *General Administrative Expense* includes all expenses in connection with the conduct of the general administration or office activities of a shipbuilding company.

6. *Fixed Charge Expense* includes all expenses such as rent, taxes, interest on fixed assets, insurance and depreciation; which are more or less fixed in character, being incurred whether the plant is in operation or not.

Prepare a chart to show graphically the accounting organization of a shipbuilding company.

14. NIVEN BOILER COMPANY—USE OF AVERAGE COSTS

The Niven Boiler Company manufactured a water and steam heating system with a standard radiator of three columns 38 inches high. When the company began its operations, costs were determined by dividing the number of feet of radiation manufactured into the total expenditures for a year. Selling prices were based on the average costs of the preceding year, and revisions were made whenever there was a substantial change in labor or material costs. The business expanded until in 1923 16 factories were producing boilers and a great many kinds and sizes of steam and water radiators. No refinement had been made in the cost system which figured costs on an average per foot on radiators and an average per pound on boilers. Relations were worked out between the standard 38-inch three-column radiator and the other sizes. In the same way a stan-

dard cost was found for one boiler, and deviations in size gave proportions with which the standard boiler cost was multiplied in order to obtain costs for each type. Since there was considerable difference in the manufacture of each type of boiler and radiator, these costs were believed inaccurate. The company had enjoyed continuous growth and substantial earnings; even through the crisis of 1920 and the following years its financial condition had been excellent. In 1923, however, a movement was started in the company to secure more accurate costs. It was believed that the company was overequipped and undersupervised, and that the use of equipment was not well balanced or correlated.

The equipment of the Niven Boiler Company was in better condition that it ever had been, but the company could not produce at the rate orders came in. This condition had become chronic. A conservative policy of expansion always had been followed, which lagged behind the increase in orders received. It was believed by those who desired to attach costs directly to each production order, that an accurate cost system would point out weaknesses in the use of equipment. This might enable the company to increase production without the addition of new equipment or buildings. To this end, test production order costs were made in 1922. Accurate costs were attached to an order of each type of radiator and boiler and checked against the average which the existing cost system gave at the end of the year. It was found that these costs varied somewhat from the average, but, as substantiated by the company's excellent condition, no discrepancy was revealed of such consequence that the financial stability of the company was imperilled. This was taken by the opponents of an elaborate cost system to be proof that no benefit would be derived by the adoption of the method of attaching costs directly to each order.

It was learned that a considerable amount of the data which would be necessary for the installation and operation of a cost department was already in the hands of the various plant managers. This information was obtained by the plant manager for the administration of his office and for the coordination of orders in the plant, but for cost accounting purposes these data would have to be tabulated.

One of the greatest differences brought out by the test method was that costs of the same product varied in different factories. This was caused by freight rates and by the antiquity of the equipment in the older plants. For example, the 38-inch three-column radiator was made in three factories and when test cases were run at these plants it was found that the average of the actual costs of the three closely corresponded to the costs found under the existing system. Apparently the only obstacle to the installation of a cost system which would attach costs directly was inertia caused by the company's past prosperous history.

15. FONDA SAW COMPANY—COST FINDING BY "LINES"

The Fonda Saw Company manufactures circular, disk, band, crosscut, and hand saws of all descriptions. A large portion of the business of the company is done on individual orders calling for saws of special sizes, numbers, and kinds of teeth, and grades of steel. Besides manufacturing for these special orders the company produces and stocks saws of standard sizes and grades, the full line of the company containing approximately 1,000 items, classified into 11 main divisions. The company does not attempt to figure costs on any single item but confines itself to charging to each main division all raw materials and direct-labor costs, together with a predetermined burden charge for each department through which the items in that group pass. At the end of the year the total sales in each line are compared with the costs of producing that line to obtain a profit and loss figure.

This method of keeping costs has not been satisfactory to the company in all respects. Because of the lack of costs on individual items the company is unable to ascertain whether or not each item in the line is profitable or is carrying its proper share of the expenses of that line. Also, since the yearly profit and loss on each line is not reduced to any unit figure, comparison between the profits of separate years on the basis of production in each line is difficult.

It has been suggested that the company change its present methods so that costs will be allocated to separate items rather than to complete lines in order to overcome these difficulties. The auditor of the company, however, strongly advises against

the proposed change on the ground that the additional information received would not warrant the increased clerical expense that the new plan would necessitate. He also argues that in order to compete satisfactorily with other manufacturers the full line would be necessary, and that even if accurate cost figures for each item were obtained they could seldom be used in setting prices or in adding or dropping particular items. Although admitting in general the arguments of the auditor, the supporters of the change believe that even if it may not be possible to drop the less profitable items, the salesmen can be instructed not to force the sale of the unprofitable saws and knives, but to push the items on which the profit is known to be largest.

Should the Fonda Saw Company make the proposed change against the advice of the auditor?

16. HUDSON TOOL COMPANY—INTRA-ORGANIZATION ACCOUNTING

The Hudson Tool Company controls the manufacture and sale of its line of small tools from the production of the steel which enters into the tools to their sale by wholesale branches distributed throughout the country. For many years the company has divided its organization into three groups as follows: (1) the factory; (2) executive department; (3) sales department. Quarterly figures of profit and loss are kept for each of these three divisions.

The factory is charged with steel from the subsidiary which produced it at the 1910 cost for producing that steel. This steel comprises approximately 85% of the raw material used in the plant. The remaining 15% of raw material and all supplies are charged against the factory at actual cost. All other operating expenses necessary for production are charged against the factory. Credit is given on the basis of an arbitrary amount for each item turned out by the production department. The size of these credits for each item has not been changed since 1910, when it was first determined. Consequently, because of the gradually increased cost since that year the factory now shows a heavy quarterly loss. In comparing the efficiency of production from one quarter to the next, not only must the size of this

loss be taken into consideration, but also figures must be compiled to give an index of labor costs and the cost of materials and supplies, other than steel, entering into the production of the tools.

The executive department is charged with the value of the goods produced by the factory as shown by the amount with which the factory is credited, under the predetermined scale mentioned above, allowed for each item. This department carries all general administrative charges, including salaries of officers, office expense, and interest. The goods are then charged from the executive department to the sales department at an amount which is determined by the price at which the goods are to be resold by the sales department, less a standard percentage which is the margin allowed the branches to cover the cost of making sales.

The sales department takes the goods at this price from the executive department, resells at prices determined in the home office, and pays for the sales expense, with the exception of national advertising, which is carried by the executive department. Since the salary of each sales manager is dependent upon the profits shown by the branch under his control, there is every incentive to reduce the amount of sales expense. Some goods are carried by the branch warehouses that are not manufactured by the company, and interest on the amount of such goods carried in stock is charged against the branch. Interest is not charged, however, on the company's own goods carried in stock.

It has been pointed out that, with the exception of the last division, the figures kept under this system have apparently little meaning. It has, therefore, been suggested that the two first divisions be done away with, saving the expense involved in the compilation of these figures. On the other hand, the supporters of the system point out that the company has been successful in a field which is highly competitive, and that this success may have been partially due to the check which the system gives on all branches of the organization.

Would it be advisable for the Hudson Tool Company to discard the established system of intra-organization accounting?

D. FOOD PRODUCTS AND CHEMICALS

17. THE HENNEPIN CHEMICAL COMPANY—COST ACCOUNTING SYSTEM IN A CHEMICAL PLANT

THE cost accounting records of the Hennepin Chemical Company are obtained from the cooperation of the works office and the general office. The works office reports the facts of operation in quantities, except that the payroll is made out in amounts. The general office places a value on the quantities reported and records these values and the summary of labor charges in the accounting books.

The Hennepin Chemical Company manufactures acetic acid, alum, liquor ammonia, anhydrous ammonia, sulphate ammonia, chloride of zinc, muriatic acid,[1] oil of vitriol, 50° Baume,[2] oil of vitriol, 66° Baume, and sulphite of sodium. The process of manufacture is different for each one of these products, but in general they are similar.[3]

[1] Commonly called hydrochloric acid (HCl).

[2] Commonly known as sulphuric acid (H_2SO_4). Commercially oil of vitriol 50° Baume is known as chamber acid, and oil of vitriol 66° Baume as contact acid. These terms designate the process by which each is made.

[3] The methods of production of chamber acid (oil of vitriol 50° Baume), bauxite alum and muriatic acid illustrate the main features in the production of chemicals for commercial purposes. It is intended that only a very elementary description of the process be given here. The accounting system does not depend on all the precise points in a chemical reaction, but rather on the nature of the process and its ability to be broken up into parts for measurement or weighing of the products. A full discussion of the Lead Chamber Process of manufacturing sulphuric acid as used in our industrial plants may be found in Molinari's *Chemistry,* Volume I, *Inorganic Chemistry,* Second English Edition, p. 296.

Chamber acid is made by burning brimstone in rotary burners to obtain sulphur dioxide, which is oxidized into sulphur trioxide by being allowed to mix with niter gas obtained by treating Chile saltpeter (Nitrate of Soda) with sulphuric acid, and water. There is still uncertainty among chemists as to the exact nature of the reactions that take place, but it is agreed that the oxides of nitrogen furnish free oxygen which either unites with sulphur dioxide to form sulphur trioxide, which is later condensed with water, or else the sulphur dioxide is condensed with water to form sulphurous acid, H_2SO_3, which in turn is oxidized into sulphuric acid, H_2SO_4. Above the lead chambers, there are towers through which oil of vitriol 60° Baume is constantly flowing in order to collect the escaping nitrogen gases which are brought back and used in the process again to furnish more free oxygen.

Niter cake, $NaHSO_4$, is present as a by-product. This product, which is formed in the reaction between sodium nitrate and sulphuric acid, is collected as a residue in the pans in which these acids are mixed. For every 20,000 pounds of sulphuric acid produced, there are about 200 pounds of niter cake. Niter is either sold or used in other processes in the Hennepin Company's plant. The chamber process is a continuous one. Sulphur is added as required. The apparatus is cleaned out whenever the lead chambers begin to show need of repair, or the acid be-

Materials. Raw materials are purchased in large quantities, in many instances a year in advance. When materials are received many of them are ready for immediate consumption, but others require grinding, drying, or other treatment before they can be used. Sulphur and bauxite, which are stored in the open, are transferred to small storerooms located in the process buildings as required. Saltpeter, lime, and similar materials which may be injured by exposure are stored in warehouses. Materials purchased in small quantities are usually stored in the process buildings. The company owns both a track scale and a wagon scale on which the materials are weighed when transferred in

comes dirty. Sulphuric acid is stored in large tanks and carboys, and is shipped in carboys and tank cars as required.

The process of manufacturing alum, $Al_2(SO_4)_3$, is one of the simplest in the plant. Its production is explained by the following chemical equation:

$$Al_2O_3 + 3H_2SO_4 = Al_2(SO_4)_3 + 3H_2O$$

Aluminum oxide is received in chunks, and is broken into small particles in a grinding machine before it is mixed with oil of vitriol 40° Baume. Aluminum oxide, which is commonly known as bauxite is obtained from North and South America, and France. Alum is always made in standard size batches; 7,600 pounds of sulphuric acid being mixed with 4,300 pounds of bauxite. A batch is agitated in a power-driven mixing tank for 4 hours, during the last 3 hours of which it is also cooked. In order to remove all dirt and foreign matter from the alum, which is in solution, the batch is filtered. The filtering process takes 2 hours. The solution then is boiled in finishing kettles until one-half the water has evaporated, a process requiring from 8 to 12 hours, depending on atmospheric conditions. The batch is then run off in steel pans about 8 feet by 16 feet in size, where it crystallizes into a solid mass about 3 inches thick. It requires 24 hours for the batch to harden, at the end of which time it is cracked by pounding it with tampers. These large chunks of alum are loaded on wheelbarrows, wheeled to a hopper, and dumped into a grinding machine. The machine used to grind alum is similar to the one used to grind bauxite but the alum is not ground as finely.

When it comes out of the grinding machine, the alum is packed in 200-pound jute bags or 450-pound barrels, both of which are lined with heavy wrapping paper. The alum is either shipped directly or placed in stock. After the mud left in the filter cloth is washed, the water drained off is used to dilute the oil of vitriol from 50° Baume to 40° Baume, and the mud is thrown away.

Muriatic acid is made by heating a mixture of salt (NaCl), and niter cake ($NaHSO_4$), or salt and oil of vitriol 50° Baume (H_2SO_4) in a mechanical furnace. The nature of the reaction is explained in the two following equations:

$$(1) \quad NaCl + H_2SO_4 = NaHSO_4 + HCl$$
$$(2) \quad NaCl + NaHSO_4 = Na_2SO_4 + HCl$$

There are two distinct methods in the manufacture of hydrochloric acid. The first method, which requires only the mixing of salt and sulphuric acid, brings an immediate reaction. The salt and sodium acid sulphate must be heated and stirred steadily in order to obtain the reaction indicated in the second equation.

The mechanical furnaces are run continuously, the raw materials being added as needed. About 400 pounds of salt are added hourly, and the sulphuric acid or niter cake is added in the proper proportions as determined by the chemical equation. The salt cake residue, which is salable, is taken out as it accumulates. Hydrochloric acid is stored in rubber-lined tanks and in carboys; it is shipped in carboys and rubber-lined wooden drums.

order to know the quantity chargeable to the departments. The storerooms provided in the buildings in which the processes are located, are equipped with small storage bins in order that a physical inventory may be taken as frequently as possible. Since these bins are all the same size, it is possible to know just how much material is in the storeroom at any time. A check can thus be maintained on the accuracy of the foreman's daily reports on material consumed.

All materials received must be reported to the general office by the receiving department. No invoices are paid unless the quantities received correspond to the purchase order and the invoice, after all adjustments have been made. The receiving clerk is always supplied with a copy of the purchase order showing the quantity and quality of materials ordered, and the cost, when that is known. A subsidiary separate account is kept for each raw material in a subsidiary ledger controlled by a raw materials account in the general ledger. The subsidiary ledger is ruled in six double columns to provide a complete record of purchases and consumption for a period of six months. The invoice cost of the material, inward freight, containers, duties, insurance, handling charges, and any other items of expense which are directly chargeable to the cost of raw materials are entered in the debit column of the raw materials account. If the material is one which loses value through evaporation or dissolution, the actual loss which occurs between the time when the product is received and when it is used is charged to the cost of the material. If incoming containers are salvaged or returned to the vendor, the amount received is credited to the material to which they were originally charged.

Since costs are collected monthly, materials are charged to manufacturing at the end of each month on an average cost basis. This average rate is determined after the works office has made its monthly report to the general offices of the quantity of materials consumed and the losses known to have been sustained from evaporation or other causes. This report is often based on estimates, since it is impossible to secure accurate figures when materials are handled in large quantities or stored in large piles in the open. Materials handled in small quantities are easily and accurately accounted for.

Since materials are weighed as used, the foreman of each de-

partment reports daily to the works office the quantity consumed. These reports are summarized weekly and the summary is sent to the purchasing department to keep the purchasing agent informed on the trend of consumption. In a rising market these reports assist the purchasing agent to determine whether or not to order before the minimum quantity of material has been reached. The monthly reports of consumption are made either from the daily report of the foremen or from a physical inventory. In the cases of liquids where no memorandum of withdrawal is kept, this second method is also used to check the accuracy of the daily reports of withdrawals from stock. The monthly reports show the opening inventory, purchases, consumption, sales, adjustments, losses, and closing inventories. The opening inventories, purchases, and sales are always reconciled each month with the general books and the raw material ledger.

By-Products. In several of the processes of the Hennepin Chemical Company, one or more by-products are given off for which the main product is credited. A standard rate has been established for each by-product. At first an effort was made to relate the standard rate to the selling price of the by-product, but when the prices of all chemicals advanced during the war, the standard rate was not changed. As a result a large profit was shown for the by-products, but only a small profit was shown for the main products.

The company defends this method, because it makes the cost of the main products comparable from month to month, and it enables the company to determine whether or not the main product is paying for itself. The value of the by-products, calculated at the standard rate, is deducted from the cost of the raw material which enters into the process. It is argued that all the labor, power, supplies, repairs, and factory overhead are chargeable to the main product, and that any credit to the main process on account of the by-product is directly due to the nature of the materials used. Hence, the standard rate is not influenced by the point at which the by-product emerges.

Proportion of Labor, Material and Overhead in the Product. The expenditures of the Hennepin Company in the manufacture of all its products are as follows: Labor 10%, material 39%,

power 12%, supplies 2%, repairs 8%, and overhead 29%. The company considers power, supplies, repairs, and fuel used directly in the processes, such as the fuel oil used for cooking alum, in the same class with productive labor. This class of expenditure is called "Conversion Cost" on the cost card. Because of the departmentalization of the plant by products, these expenses are chargeable directly to the products.

Labor. When the plant is operated at capacity, 450 men are employed, but during slack seasons the payroll has been as small as 325 men. This number does not include foremen, chemists, works office employees, and others who receive a salary. The manufacturing operations require little labor because many processes are run continuously with mechanical equipment. The handling of material and finished products requires the largest proportion of direct labor, and approximately 95% of the labor of the service departments is charged to maintenance or plant construction.

Each man employed on an hourly wage is given a "Hiring Slip" by the employment manager, which gives authority to the timekeeper, who is also the paymaster, to assign him a time-clock number. Every laborer is required to punch the time clock whenever he enters or leaves the plant. Both the direct- and indirect-labor costs are determined from the time-clock record. The number of hours each man has worked, obtained from the time-clock ribbon, is entered on a payroll sheet headed as follows:

S	M	T	W	T	F	S	Explanation	How Employed	Number	Name	Hours	Rate	Amount

At the end of the week the hours are extended and multiplied by the rate to obtain the total amount of wages for the week. A carbon copy of the payroll, excluding the columns for days of the week, is sent to the general office. This copy is both the notification to the cashier of the amount of money to be paid and the record used by the general office to audit the payroll.

In order to have a check on the efficiency of labor within

each department, the labor records for each process are divided into operations. For instance, in the manufacture of alum the cost of labor is classified as follows: Grinding bauxite, mixing bauxite and sulphuric acid, cooking, filtering, evaporating, cracking, grinding, filling bags or barrels, and cleaning up. The foreman of each department sends to the accounting department of the works office a daily record of the work of the men in his department, explaining what they did, the length of time they were on the operation, and their rate of pay. The foreman's time is not included, because his work is entirely supervisory. A check on the accuracy of the reports for time and amount is obtained by cross-totaling. The total time is also checked for accuracy with the time-clock records. The daily reports are summarized by operations on sheets, having a column for each type of work performed. The weekly or monthly cost of any operation in any department may be obtained by adding the columns in which that operation is summarized. In order to get a complete cost by operations, the salary of the foreman is prorated on a percentage of labor cost.

There are two different payrolls at the factory. All employees who receive an hourly wage are paid weekly in cash. One check on the payroll procedure is the fact that all payments are witnessed. Persons employed on a salary are paid monthly by check. A weekly and a monthly distribution of labor costs from both payrolls are prepared which include the cost of labor chargeable to every department in the plant both in total and in subdivisions of operations. The weekly summary is purely statistical, but the monthly summary is the authority for a journal entry crediting the payroll and debiting the various subdivisions, for which accounts are kept in the factory ledger. Accruals as well as actual expenditures are included in the weekly and monthly distribution of labor costs.

A statistical analysis of the weekly payroll is made showing the following facts:

1. The cost of direct labor, and production in net tons, in each of the manufacturing departments
2. The cost of labor in each of the service departments, the wages of janitors, watchmen, stablemen, clean-up men, and other indirect labor

3. The cost of labor chargeable to maintenance
4. The cost of labor chargeable to plant construction
5. The cost of labor chargeable to handling of raw material
6. The cost of labor chargeable to the handling of finished goods
7. The cost of labor chargeable to the manufacture and maintenance of carboys
8. The cost of labor chargeable to cooperage
9. The cost of labor chargeable to filling containers
10. The cost of labor chargeable to handling freight
11. The cost of labor chargeable to cleating of cars and marking shipments

Power, Light, Heat, Compressed Air, and Water. Power is an important item of expense, constituting 12% of the total cost of all the products of the Hennepin Chemical Company. The first cost of power is the generation of steam, which includes the cost of labor, fuel, supplies, and taxes, insurance, repairs, and depreciation on investment. The steam generated is charged out of the steam-generating department to the compressed air, elecricity-generating, and steam-distributing departments at a unit cost per 1,000 pounds of steam delivered.

The steam furnished to the distributing department is used in the manufacturing processes and for heating. Because the cost of maintaining the piping system increases the cost of this steam, a new rate per 1,000 pounds is calculated as a basis for charging the manufacturing departments. Bailey steam meters are used to measure the amount of steam consumed by the important manufacturing departments, but the amount of steam charged to the other departments is estimated from the production. Tests are made from time to time by metering the steam into a department for several days to determine the amount of steam required to produce a ton of product. Since meters are attached at the departments instead of at the point where the steam leaves the boilers, any waste of steam which occurs from radiation during distribution is neglected. The amount of steam lost, however, is small because the pipes are well protected with asbestos covering.

The steam consumed by the electric generating department is about one-third of the cost of generating electricity. Other

costs in this department are labor, oil, supplies, and the fixed charges on the equipment and building. Electricity is charged to the consuming centers at an average cost per kilowatt-hour. As in the distribution of steam, the electricity is metered to the most important consuming departments. The quantity of electricity furnished the other departments is estimated from the number of kilowatts required to produce one ton of product. The horse-power requirements of the motors are also used as a guide in making these estimates.

The cost of fresh water, salt water, and compressed air is included in the power costs of the Hennepin Company. Inasmuch as fresh water is metered into all the departments, an accurate cost may be obtained. The only cost of supplying salt water is that of pumping it directly from the ocean to a distributing tank. The salt water pump is considered part of the equipment in the electric generating department. Compressed air is used principally to transfer acids from one building to another by blowing them through lead pipes. The cost of salt water and compressed air is charged to the departments using them on a basis of arbitrary percentages determined monthly by the engineering department from actual production and past experience.

Supplies. About 4,000 different articles are handled in the supplies storehouse. A perpetual inventory with a balance-of-stores card for each article is maintained. At the end of each month the storekeeper makes a report of requisitions filled from the original requisition slips which have been filed by departments. The duplicates are filed by articles and used as the authority for posting to the balance-of-stores cards.

In order to save handling expenses, supplies are delivered whenever possible directly to the manufacturing departments using them. Storehouse expense comprises inward freight and handling charges on supplies, salaries of storekeepers, and fixed charges of the storeroom. This expense, which is usually about 10% of the value of supplies used during the year, is absorbed by adding 10% to the value of supplies used for plant construction and maintenance and prorating the remainder to the value of supplies used by the manufacturing and service departments.

Repairs. The chemical action of the products on the ap-

paratus and buildings makes frequent repairs necessary. Because the expenditure for repairs varies in a marked degree from month to month, a standard charge for repairs is made each month and an account "Reserve for Repairs" is credited. In order to make costs more uniform, actual expenditures for maintenance are charged to a repairs account. At the end of each year the reserves are adjusted to the annual expenditures, because it is deemed wise not to carry forward on the balance sheet a deferred debit or deferred credit on account of repairs.

It is difficult to anticipate the requirements for repairs during the year with any degree of accuracy, but a careful study of plant conditions is made by the cost accounting department of the works office in cooperation with the engineering staff. Statistics on repairs are collected as a guide in determining the amount to be charged monthly. A separate card is kept giving the original cost for each apparatus and each building and all expenditures for repairs. Repair charges consist only of labor and material consumed. None of the overhead of shops is included. Some consideration has been given to charging the overhead of the shops to maintenance and plant construction on the basis of the distribution of labor-hours in each of the shops. Inasmuch as this method would require additional work, the advantage to be gained is questionable in the light of the additional cost.

Burden. The overhead expenses, which are 29% of the manufacturing costs, are classified into taxes, insurance, depreciation, works administration, laboratory and general expenses. The Hennepin Company owns its real estate and buildings, but neither rent nor interest on invested capital are charged as a cost because they are considered to be only an anticipation of profits.

Taxes, 12% of Burden. The amount of taxes on both real estate and equipment, which is always known at the beginning of the fiscal periods, is distributed to departments according to the value of the equipment in them, the value of the buildings having nothing to do with the distribution. Each apparatus is valued at cost, and the valuation is not changed unless there is a replacement at a higher or lower price than the original cost.

Insurance, 9% of Burden. The insurance charges include protection against fire, explosions, and workmen's disability com-

pensation. The premiums on explosion insurance, which is carried in specific policies, are charged directly to the department in which the explosion may occur, regardless of the fact that an explosion may damage adjoining departments. Since premiums on workmen's compensation insurance, which amount to almost $35 a year per capita, are based on the payrolls, they are charged to departments on the basis of labor costs within the departments. Fire insurance, which is carried at a blanket rate, is distributed to departments according to the value of the equipment.

Depreciation—33% of Burden. Depreciation is charged on a straight line method. Buildings are depreciated at the rate of 5% per year on cost, and equipment at the rate of 7½% per year on cost. This low rate is made possible by the large expenditure for maintenance. Obsolescence is a factor in the chemical industry, but all charges of this nature are provided for in the charge for depreciation.

Works Administration—19% of Burden. The works administration expense, which includes all cost incidental to the works office, is distributed to the manufacturing departments on the basis of manufacturing labor costs.

Laboratory—5% of Burden—A laboratory is maintained at the plant where chemists are employed to test the products and to carry on research in the field of industrial chemistry. Research expense is charged to surplus, and is not considered a cost of manufacturing. The cost of testing a product is charged to the department for which the test or experiment was made on the basis of the chemist's time. Overhead expenses of the laboratory are distributed on the basis of the chemist's time.

General Expenses—22% of Burden. General expense includes the overhead of the shops, indirect labor not chargeable to repairs and plant construction, trucking and teaming, and other miscellaneous expenses.

Shops. The Hennepin Company maintains the following shops: Blacksmith, carpenter, electrician, mason, machine, pipe, plumber, and paint. Only a small percentage of the labor of these shops is not definitely chargeable to repairs or plant construction. When the payroll is prepared, it is classified by

departments in order that the total amount of wages paid to employees in any department will be known. The amount of wages chargeable to maintenance and plant construction, however, is credited to the shop accounts, and the balance, if any, is added to the overhead of the shops, which is distributed to the manufacturing departments on the basis of direct-labor costs.

Trucking and Teaming. The company owns eight trucks of different makes and several yard and road teams. Detailed records of all trips are kept showing their length and the product hauled. The accounting records are kept separately for each truck in order to secure individual costs. The time of the drivers and helpers when loading or on the road is charged to the individual trips; all other time is included with the cost of maintaining and operating the trucks, which is charged monthly to the product hauled on the basis of ton-miles. The total cost of hauling by road teams is kept in a separate account, and is distributed monthly on a ton-mile basis. The total cost of operating yard teams is charged monthly to the work reported done.

Railroad Locomotives and Tank Cars. The Hennepin Company owns a spur track, two locomotives, and 30 tank cars. The cost of maintaining this equipment is kept in three separate accounts. The railroad and locomotive expense is charged proportionately to the cars handled, so that the final distribution to the product depends upon the material in the cars. In the case of mixed carloads of supplies, the cost of handling is charged to the Supplies-Freight-Handling account, which is prorated to supplies in a manner already described. Whenever the cars handled contain an unmixed lot, this cost is charged directly to the material handled. The cost of maintaining the tank cars is charged to the materials hauled.

Cooperage. The company makes its own barrels and wooden containers. Two kinds of barrels are made, one for dry materials and the other for liquids. Labor in this department is either expended for the manufacture of containers or for their repairs. As already explained, the foreman makes a daily report of the distribution of labor to the works office, which uses this report as a basis for distributing the overhead of the cooperage shop. The cost of the returnable containers is charged to

capital, but depreciation on the containers is added to the maintenance expense of the department, which is distributed monthly to the products shipped.

Carboys. The bottles, shooks, and other parts of a carboy are purchased separately and assembled by the company. This department brands and rebrands the carboys, washes them upon their return from a customer, and keeps them in repair. The cost of the new carboys is charged to capital, but depreciation, which is included with the expense of maintaining them, is charged monthly to the products shipped. All containers are depreciated on the basis of the average number of trips that can be made.

Steam Crane. The company maintains a steam crane for unloading and loading ships and for unloading heavy material from freight cars. The cost of maintaining this crane is charged to the material handled on the basis of operating labor costs of the crane.

Miscellaneous Expense. The cost of maintaining a fire protection and accident department, the expenses of the drafting room, and the wages of watchmen and yard men, and miscellaneous expenses are charged monthly to the manufacturing departments on the basis of direct-labor costs.

Idle Time. No charge arises for idleness of men, since they are paid an hourly wage for time worked only. Daily records, which are summarized at the end of each month, are kept of idleness of units and departments in the plant. A minimum of six days is set, below which no account for idle time is taken, so that at the end of the month the usual amount of fixed charges is entered on the cost card. But if a department has been idle more than six days, the percentage of idleness is calculated on the basis of the normal number of working days in the month. This percentage is applied to the total amount of fixed charges, and the result is deducted from the manufacturing costs on the monthly cost sheet and charged to profit and loss regardless of the cause of the idleness.

Monthly Production Reports. Each month the works accounting department reports to the accounting department of

the general offices the quantities of each product produced during the month. Whenever possible, this report is made from actual records of production, but in some continuous processes it is difficult to measure directly the quantities manufactured. In the case of sulphuric acid, the production is estimated by the inventory method; the stock on hand at the beginning of the month is known, and by measuring or weighing, the stock on hand at the ending of the month is ascertained. The quantity shipped, which is obtained from the shipping department, is added to the closing inventory; the opening inventory plus purchases, if any, are substracted from this sum in order to secure the quantity produced. Adjustments are made, of course, for any known losses.

Measures of Efficiency. Besides being the basis for determining the proportion of materials to use in a process, chemical equations are used to determine the efficiency of a process. The quantity of product obtained is divided by the quantity which should have been obtained according to the chemical equation, which gives the percentage of efficiency. The number of tons of product produced per man-hour is determined separately for each department. These results are plotted on graph paper in order to provide the works manager with a weekly comparative check on the efficiency of labor. Expense reports are made on columnar sheets to afford an easy comparison from month to month. A check on economy is maintained by requiring the expense statements to be made out in detail.

18. HAMPSHIRE VINEGAR COMPANY—COST ACCOUNTING SYSTEM

Mr. Craig, owner of the Hampshire Vinegar Company, took his son into partnership in the spring of 1919. During the following year of exceptional business activity, the company experienced difficulty in securing its chief raw material, sweet cider, when needed and in the necessary quantities. At the same time a demand arose for vinegar in small bottles ready for distribution to the ultimate consumer. Largely as the result of persistent urging by his son, Mr. Craig consented to add cider-making and bottling facilities to the plant. A small building was constructed on land already owned, and the cider-manufacturing equipment was installed, while bottling machinery

was placed in a small, separate building previously used for storage. The improvements were made at the peak of high costs. As the depression of 1921-22 progressed, both father and son began to doubt the wisdom of their action, and made a complete survey and analysis of the situation. Among other things, they were anxious to obtain a per-gallon cost of the cider mill and bottling plant operations.

Cost accounting had not been used in the Hampshire plant in the past. No stockrooms nor method for stock control existed. The management had no knowledge of physical material in process; only by summation of the amounts on bills to customers could the year's production be determined. They desired some method of following the movement of physical stock, and sufficient cost records to determine at the end of the year the per-gallon cost of manufacturing the various products. At the same time Mr. Craig was unwilling to spend the money necessary to obtain the refinements of cost accounting which might be justified in a larger plant.

A cost accountant was employed to whom the following description of the plant and processes was supplied, as an aid in studying the situation.

Physical Plant. The plant consists of a large, old, wooden factory building and the two smaller buildings containing the new departments. The buildings are connected with the railroad by a spur track, built and maintained at the company's expense. All buildings, land, and equipment are owned outright, with the exception of about 10,000 square feet of land rented from the railway company, which is occupied by the spur track and by sheds containing four large storage tanks, as well as space for empty-barrel storage. All administrative work is carried on in a small office in the front of the factory building.

Processes

General Process. Vinegar [1] making is essentially a chemical process. The sugar of apple juice or sugar syrup is changed to alcohol, which, in turn, is changed to acetic acid (vinegar) by oxidation. The latter change is accomplished by exposing the fermented juice to warm air while trickling through vats filled with shavings, known as generators. The acetic acid thus made is usually stronger than the 4% acid strength required by law, but it can be easily reduced to that strength by the addition of water.

[1] In 1921 the Hampshire Company made approximately 750,000 gallons of product divided as follows: Sweet Cider, 20%; Cider Vinegar, 35%; Sugar Vinegar, 25%; and White Vinegar, 20%.

Sweet Cider Process. After being received in carload lots, the apples are unloaded into carriers which take them directly to the top of an apple grinder. There they are ground into a fine pulp and dropped immediately into large hydraulic presses which remove the greater part of the juice by two applications of pressure. The pulp is then carried to the top of a machine called a picker which breaks up the hard mass and drops it into a second hydraulic press where any remaining juice is removed. The juice is emptied into large storage tanks where a small quantity of benzoate of soda is added to prevent fermentation. The cider is now in final form ready to be bottled or barreled as needed for shipment.

Cider Vinegar Process. The first step in cider vinegar manufacture is the making of sweet cider as already described; no benzoate of soda is added, however, and fermentation is allowed to proceed for three or four months. At the expiration of that time, all sugar in the apple juice has become alcohol. The fermented juice is pumped to feeding tanks, from which it trickles slowly through the generators. The alcohol must be run through the generators twice in order to get the complete oxidation necessary to produce acetic acid. This process is extremely slow, requiring from six to eight months for the generating of the year's product. After dilution to 4% acid strength the vinegar is ready for shipment. The turnover of this product is but once yearly.

Sugar Vinegar Process. Sugar vinegar is made from sugar syrup, a by-product of sugar refineries. The syrup is placed in mixing tanks and a small quantity of yeast is added. Fermentation takes place exactly as in the case of cider vinegar, but is completed within two weeks, when the liquor can be passed through the generators in the same manner as the fermented apple juice. Sugar vinegar can usually be completely oxidized in one passage, and is then stored until needed for shipment. This product, which can be manufactured continuously, has a turnover rate of from four to five times a year.

White Vinegar Process. Concentrated white vinegar, which is a by-product of distilleries, is purchased by the Hampshire Company, stored until required, and then diluted with water to the required strength. This product is not manufactured, but is carried to complete the line.

Departmentalization

Cider Mill. The cider mill is in a small frame building entirely separate from all other departments. It includes a storage shed for apples. The equipment consists of two hydraulic presses, an apple grinder, a picker, and a conveyor system, all operated by two electric motors. This department operates only during September, October, and November, when apples are being gathered. About 25 men are required for handling the apples and operating the presses. All are on a day wage, and no skilled labor is necessary. Apple pulp is a by-product of this department. This is loaded on cars and sold as

fertilizer, bringing enough return to cover handling charges and cost of transportation.

Storage. All tanks for storage of product in process, as well as finished product, are included under this heading. Twelve tanks are located in the factory building and twelve in sheds in the yard. Their upkeep, depreciation, and space costs would be the chief charges to this department.

Generating. There are 16 large tanks or generators in a room in the top of the factory building. Three generators run sugar vinegar throughout the year. The remainder run cider vinegar from January until September. One man can attend to the flow of vinegar, and make tests for acidity at three-hour intervals. Generators must be repacked with shavings every three years. When a generator has been newly packed, about 500 gallons must be trickled through to "charge" the new shavings. This vinegar is lost and becomes a cost of the generating process. The generating room must be heated in very cold weather but in normal weather the process develops sufficient heat to maintain the required temperature of 80 to 90 degrees Fahrenheit.

Pumping. All pumping is done by two pumps driven by a steam engine in the main factory building. During manufacture, cider vinegar requires seven pumpings; sweet cider, three pumpings; sugar vinegar, five pumpings; and white vinegar, two pumpings. Hose and pipe connections are included under this department. One man is able to handle all pumping.

Bottling. The bottling department is located in one of the small separate buildings. It is operated by separate electric motors, and the equipment consists of one filling machine and one capping and labeling machine. When material is to be bottled, it is pumped from the storage tanks to a feed tank on the second floor where it is diluted with water to the required strength. The vinegar then feeds by gravity through the filling machine into bottles, which then pass through the bottling and labeling machines. Only two or three operators are required to watch the machines and to remove the bottles, which are packed in wooden cases and are shipped directly from this department. Bottling is carried on continuously from July to November, and intermittently during the rest of the year. The cost of bottles is included in the vinegar selling price. No separate charge appears on invoices and bottles are not re-purchased to any appreciable extent.

Barreling. Vinegar to be barreled is pumped into a feed tank, where it is diluted to the desired strength, and is then drawn off into barrels through strainers. Standard barrels are of 50 and 25 gallon capacity, although many odd sizes are used. Barreling is carried on in the main factory building, and shipments of barreled products are made from a room in the front of the building. One man handles all shipping during eight months of the year, but from August to November he

requires the assistance of two or three additional men. In 1921 about 50% of the product was sold in barrels, the remainder being bottled.

Cooperage. The company charges all barrels to customers on invoices. These are re-purchased at a slightly depreciated rate, and are cleaned, repaired, and painted in a room in the main factory building. One man spends his entire time on this work, with occasionally some additional help. Storage of barrels requires considerable space both in the factory building and in the sheds.

Distribution of Space in Factory Building to Departments. Storage, 40%; Generating, 10%; Office, 5%; Cooperage and barrel storage, 25%; Power plant, 10%; Shipping of barreled products, 10%.

Materials

Major Materials. Apples, sugar syrup, concentrated white vinegar, hard cider.

Minor Materials. Benzoate of soda, yeast, strainer and press cloths, shavings for generators, bottles, caps and labels, barrels, crates for bottles, coal, pipe fittings and hose, and small supplies for factory and office.

Labor

Only eight men are employed continuously throughout the year. With the exception of the cooper, their time is divided among a variety of jobs making allocation of time difficult. All are on a weekly wage and all are unskilled, with the exception of the foreman who controls the generator flow, and tests the product. From August to November 20 to 25 additional men are employed, chiefly for work in the cider mill and bottling plant. All are unskilled and are on a day wage. The office force consists of the proprietor and two girls who handle bookkeeping, correspondence, sales and purchases.

General Information

Measurement of Product. The product can be measured fairly accurately during the pumping process by installing a flow meter in the hose lines, although rough measurement can be made while the product is standing in the tanks if the total capacity of the tank is known. The volume of liquid varies during the process owing to evaporation, but as the concentration becomes greater with evaporation there is no loss of value. No measurement of quantity has significance, however, unless accompanied by a sugar, alcohol, or acid test made at the same time.

In laying out a system for collecting costs and distributing them to product, the following difficulties were encountered:

1. *Barrels* are charged and credited to customers through a barrel account in the general ledger, but repairs to barrels are

charged to cooperage on the cost books. Should a debit or credit balance in the barrel account at the end of the year be closed to profit and loss on the ground that appreciation or depreciation of containers is not strictly a cost of doing business, or should the balance be closed to cooperage? Since cooperage is a service department, the cooperage account might be closed to overhead, but as only about half the product is sold in barrels and that half is made up of varying proportions of the different products, this step would be inadvisable. It has been suggested, therefore, that cooperage be distributed to barreled product as a per-gallon or per-barrel charge, to be determined by past experience.

2. *Spur Track.* The spur track is used for a number of purposes in approximately the following proportions: receiving cars of apples 40%, receiving cars of sugar syrup 15%, receiving miscellaneous supplies and equipment 10%, shipping product 10%, shipping pulp 25%. Inasmuch as the spur track was built primarily to serve the cider mill, Mr. Craig wishes all track expense charged to the mill, but his son maintains that as long as other departments have the use of the track they should share its upkeep. Under this latter plan, if a new tank arrived by rail, would a spur track charge become part of the cost of the tank and be placed in an asset account, or would the charge be made to the storage department?

3. *Purchase of Hard Cider.* If sufficient cider is not made by the company to supply its vinegar needs for the year, hard cider is purchased during the winter. If the purchased cider is charged at actual cost, the average cost of cider vinegar in process coming to the generators will represent a composite figure of uncertain significance. If the purchased cider is charged at a per-gallon cost equal to the cost of cider made in the company's mill, with any difference carried in a suspense account, no computation will be necessary to obtain the manufacturing cost, but to obtain the actual total cost of the finished product, it would be necessary to add or subtract from the total cost the amount carried in suspense. The second plan gives a comparable measure of manufacturing efficiency; the first plan gives the actual cost of work in process at any time.

4. *Cost Unit.* Vinegar in process is of varying concentrations owing to evaporation. Products sold are in a concentration of 4% acid strength, on which the selling price is always based. Should a gallon of average concentration as determined by numerous tests of work in process, a gallon of 4% strength, or a gallon of liquid regardless of concentration be used as the cost unit? If either of the first two units is adopted, it will be necessary to adjust all measurements to terms of the unit in order to make the results comparable. Although the last unit requires no extra computation, the results are of use only where physical volume alone is of interest, regardless of the amount of salable product represented.

5. *Length of Cost Period.* The selling price of vinegar is determined entirely by the market regardless of actual cost. In view of this fact and since the production period for cider vinegar is one year, and for sugar vinegar two to three months, would it be necessary or advisable to attempt to obtain costs on a month or four-week basis, or would yearly costs be sufficient? Immediately the attempt is made to secure costs on other than a yearly basis, many items paid in lump sums at infrequent intervals must be carried in reserve accounts divided into monthly parts, and charged out each month. This method involves additional bookkeeping labor, but once the system is established the monthly entries can be made quickly, if it is thought that a more exact picture of the financial condition of the business is thereby obtained.

6. *Returns of Sweet Cider.* Sweet Cider often ferments after shipment. When this is returned by customers it is placed in process to be made into cider vinegar. Should the transportation cost of returning cider be charged to selling expense, returned goods, or profit and loss, or should a special account for spoilage be set up? If charged to returned goods it will become a deduction from gross sales. Should charges from this cause be differentiated from cost of returned goods sent in error by the sales department?

7. All important materials go into process immediately upon arrival at the plant. Should the company charge all costs immediately to the appropriate goods in process account, or should it keep material and other primary accounts?

8. Vinegar is put up in one-quart, two-quart, and one-gallon bottles. In 1920 approximately 200,000 gallons of vinegar were sold in gallon bottles, 75,000 gallons in two-quart bottles, and 25,000 gallons in one-quart bottles. Should bottling costs be determined on a per-gallon or a per-bottle basis?

9. Sweet cider is in storage during process and awaiting shipment from two weeks to six months; cider vinegar from four to twelve months; sugar vinegar from two months to five months; and white vinegar from one week to six months. Total storage costs, including depreciation and maintenance of tanks, do not exceed $2,000 yearly.

The year's total days might be reduced by average idle days and the active days divided into the yearly cost of maintaining each tank, thus obtaining a tank-day charge. This figure, divided by the average quantity of product using the tank, would give a gallon-day rate for charging storage. Another way of handling storage would be merely to divide the yearly cost of tanks into parts proportioned to the output of the various products, multiplied by their average days stored in a year. The storage charge for each product could then be divided by the number of gallons intended to be made during the year, giving a per-gallon rate.

10. In the past Mr. Craig, Jr., has made a trip through the farming regions each fall purchasing apples, although it is possible to have apples bought on commission by local buyers. In buying apples for making cider, the price, kind and sugar content are important factors. Mr. Craig wishes to determine the relative cost of the two methods, over a period of years, by alternately buying himself and through an agent, but it has not been decided whether buying costs should be determined on the basis of apples purchased or product resulting. If apples purchased is used as a basis, no account would be taken of a lower sugar content which would result in a smaller cider yield; on the other hand, since some seasons all apples have less sugar content normally, a comparison of the product resulting might not be fair to the agent.

11. All products are not pumped the same number of times during process, (see paragraph on Pumping in description of

departments) nor are their concentrations constant. If the pumping costs are distributed according to actual gallons pumped, a good measure of pumping efficiency is secured and the costs are on a comparable basis from the pumping standpoint. If the pumping costs are distributed on a basis of gallons of 4% acid strength, these costs are comparable with the costs of other operations on the vinegar, which would not be the case if the distribution was made on actual gallons pumped.

12. The main factory building was built in 1880 at a cost of $25,000. There has been no systematic depreciation, and no record has been kept of expenditures for maintenance. In 1916, $3,000 was spent in repairing the sills and foundations, and $1,000 for replacing the roof covering. Replacement cost as of October, 1921, was placed at $50,000; assessed valuation was then $15,000. The estimated life of the building, without major repairs, would probably be from 15 to 20 years, but it is likely to be condemned by the building inspector at any time. The three bases of valuation in common use are original cost, replacement cost, and earning power. On the basis of earning power, Mr. Craig wished to set up the building value at $30,000 and depreciate it $2,000 yearly, but the accountant objected because of probable obsolescence, suggesting a $15,000 valuation, to be written down $1,000 yearly.

13. Accounting for pulp may be kept separately, showing a definite profit or loss from the sale of the by-product. Mr. Craig objects to this refinement on the basis that the costs charged pulp would not be exact unless overhead were added. He wishes to charge pulp-handling expense and credit its selling price directly to cider mill. If the pulp cost and sales were kept separately, should the account be closed to cider mill or profit and loss?

19. THE VITEX CHEMICAL COMPANY—CREDITS TO MAJOR PRODUCTS FOR BY-PRODUCTS AT STANDARD RATE INSTEAD OF MARKET RATE

The Vitex Chemical Company manufactured 20 major chemical products. Two of the major products were muriatic acid and nitric acid, which were sold for general commercial use.

During the manufacture of muriatic acid, a by-product was obtained in the form of salt cake, the value of which normally was about 80% of the value of the muriatic acid. Nitric acid also yielded a by-product, nitre cake, the value of which averaged 2% of the value of nitric acid. In each case no further manufacturing processes were necessary to make the by-products available for marketing. The by-products were charged to finished stock accounts, into which were closed also the expenses of handling, storing, and packing them. In setting up cost accounts for these major products, the company had to decide upon a suitable method of crediting the accounts for them with proper amounts representing the by-products.

One plan which could be followed was to debit the by-product accounts and credit the main product accounts at a rate based directly upon current market prices for the by-products. As the manufacturing accounts were closed each month, the use of this plan would mean that the average market prices for the month would be taken as the figure at which credit to the main product accounts should be made. The market prices of the two by-products were subject to marked fluctuations from month to month. They were used chiefly in the manufacture of textiles, and prices for them fluctuated with the volume of textile output. There would be no additional expense to the company in keeping accurate data on the market prices of its by-products, and the average current rate could be used as readily as could a standard rate. The use of the current price would mean, however, that the main product accounts would be credited each month, at varying rates, for the amount of salt cake or nitre cake produced. As a result, a variable element would be introduced into the manufacturing cost of the finished main products, and cost data for the latter would not show, from month to month, the correct ratio of manufacturing costs. If the standard rate were adopted, the two main products would receive monthly credits for the by-products, which would vary only with the amount of by-products manufactured. The selling price of the by-products would have no influence, and the manufacturing costs would yield comparable data as an index of manufacturing conditions and efficiency.

The use of the standard rate would make it necessary for the company to determine upon a suitable standard, which would

be based upon a fair average price at the time the standard was established. In subsequent periods, the market price of the by-products would continue to fluctuate, and the by-product accounts, therefore, would show large profits in some months and slight profits or possible losses in other months.

The main products also would be subject to variation in selling price. Profits on the main products could be analyzed by comparison with the corresponding profits on the by-products whenever the company should deem such action necessary. If the fluctuating market value of the by-products were allowed to enter the manufacturing cost of the main products, the question eventually would arise as to which were the main products and which the by-products.

In order to secure comparable manufacturing statistics and to maintain the identity of the main products, the company decided to use the standard rate, with the provision that the standard could be changed at regular intervals of a year or more, provided there were permanent changes in the market values of the by-products. This provision was expected to prevent basic changes in market prices from affecting permanently the relative profits shown on main products and by-products. The decision to use the standard rate for crediting main products and debiting by-products was made because the company wished to keep out of manufacturing costs the variations arising from the fluctuating selling prices of the by-products.

20. THE DUELL SOAP COMPANY—DISTRIBUTION OF COSTS TO TWO PRODUCTS

Several attempts had been made by the Duell Soap Company to distribute production and material costs equitably to soap lye glycerine, and soap, which were obtained from the same batch of materials. None was considered successful, although one had been used for nine years before its discontinuance. Upon the cessation of this plan, the company decided to make no effort to prorate the costs.

The ratio of soap to soap lye glycerine, obtained from one batch of material, was approximately 17 pounds of soap to 1 pound of soap lye glycerine. In April, 1923, the value of one pound of soap was 10 cents; the price received by the company for one pound of soap lye glycerine was 12 cents.

In the manufacture of soap, the first process is kettling. The superintendent of the kettling department requisitions materials from the receiving department upon the receipt of an order from the production manager for a batch of soap. The materials which enter each batch are stearine, caustic, resin, and salt. In the Duell Soap Company six kettles are run at the same time, and all charges such as labor, steam, and water are distributed indirectly. Six operations are carried on in the kettling department—saponification, graining, strength changing, fixing, boiling, and kettling.

The contents of the kettle separate into three products at the end of the kettling operation. The soap is on the top; beneath it is spent lye; and at the bottom, nigre, a low grade of soap. The top layer of soap is drawn off to the next department for the subsequent operations in its manufacture. Spent lye is drawn off to the glycerine department for the manufacture of glycerine, and the nigre remains to be boiled over in the following batch. It was at this point that effort had been made to divide the costs and apply them to the spent lye and soap. Separate costs were easily ascertained after this operation, as there were eight manufacturing processes through which the soap passed, and five operations for the completion of the manufacture of glycerine. The only method which had been applied for this cost distribution longer than a test period had been that of debiting the soap with all charges in its manufacture, which included total kettling charges, and crediting it with the profit made on the glycerine based on a standard price for glycerine. The prices of glycerine for several years had been averaged and a standard price adopted. From this price were deducted the operating costs of the five operations after kettling, and the remainder was considered profit and deducted from the total soap charges.

This system had been used for nine years, but it had been discarded because of the fluctuations in the market price of glycerine, and since the standard remained fixed at all times, the corresponding profit credited to soap had been a false figure. During the war the price of soap lye glycerine had risen to 45 cents a pound;[1] this method showed all the profit on the books as having been made on soap. The company decided that since this

[1] *New York Commercial*, April 10, 1918.

method did not give accurate results, it would be better to discontinue the plan and make no charge to lye other than that for the operations subsequent to the kettling process. In this method no debit was made to spent lye for material, and profits shown for the glycerine were selling price less operation charges after the kettling. The charges for subsequent processes were quite small as the operations required little skill. It was believed impracticable to follow the market of glycerine and make each credit to soap according to the market value of glycerine, since the kettling process was continuous and removals of glycerol (spent lye) were made at different times.

For cost purposes, the company did not departmentize the glycerine operations, but kept costs only for the entire department. Spent lye, which was separated from soap during the graining operations of the kettling department, contained about 4% to 8% glycerol and 15% salt. The lyes were treated and concentrated until the glycerine content was at least 80%. The salt in the spent lye was reclaimed and again used in the process of boiling. The lye was run from the kettles to tanks in a storage room and rendered slightly acid by the addition of muriatic acid and aluminum sulphate. It then was filtered and rendered alkaline by the addition of a caustic solution. The next operation was concentration, and in this operation, the liquid was evaporated in vacuum. Meanwhile the salt was thrown out in solution and pumped over to centrifugal dryers. Concentration continued until the liquid attained its 80% concentration. After the concentration operation, the glycerine was ready for market.

21. LEIGHTON SUGAR COMPANY—ACCOUNTING SYSTEM

The Leighton Sugar Company owns two sugar-beet factories in Minnesota and Iowa which are normally idle from January 1 to October 1. As soon as the beets are harvested, factory operations start, and continue until the supply of beets has been manufactured into sugar. Since the company is never satisfied that a profit has been made until the entire output of a year has been sold, the season's production is the unit of cost. In 1921, 43,000,000 pounds of sugar were produced and sold. Ordinarily,

the complete production has been sold by June 1, but in 1921 the stock was not cleaned up until August.

The two classes of expenses incurred between January 1 and October 1 are: Agricultural expense, maintenance, and repair expenses of the factories. The agricultural expense begins with the securing of acreage. A representative of the company begins to call on farmers as early as January to solicit contracts to grow beets. There are three types of contracts used: first, the flat rate contract under which the farmer receives a set price for a ton of beets, regardless of the sugar-content or the price of sugar; second, a contract with a minimum price per ton with an upward scale based on the price of sugar above a specified point; and a third, a contract with a minimum price per ton of beets with an advancing price based on sugar-content. Under the two last-mentioned contracts, it is difficult to determine the cost of beets because of elements which are not known until the beets are harvested; the sugar company is also able to pay more on the average for the beets because the farmer assumes part of the risk.

The contracts with the farmer ordinarily contain other stipulations. One which is common is an agreement to assist the farmer in securing hand labor required in thinning, hoeing, and digging the beets. Since the Leighton Company is in touch with the city labor market, it sends men to the farmers, but it must bear the expense of their transportation and their maintenance at hotels until the farmers have called for them. The company also bears all cost incidental to their care in case of sickness.

All territory in which sugar-beets are grown is assigned to agents, each of whom is usually placed in charge of two counties. The agents are responsible for securing acreage and superintending it while the beets are being grown. Among other things they give instruction bearing on the preparation of the seed bed, method of planting, time of seeding, and method of cultivation. The agents begin as early as July to send to the factory, from the various sections of their territory, sample beets which are analyzed for sugar-content. On the basis of the estimated tonnage which is reported weekly by the agents, the production of sugar and, in turn, the cash receipts for the season are estimated. From this information, the budget for the year

is prepared. All operations, prior to the time of harvesting and the starting of the factory, are governed by the estimated profits as shown by the budget. If the sugar production appears to be small, the manufacturing cost per ton will be increased, and an effort must be made to keep the production cost low enough to enable the company to show a profit on the season's operations. The budget is revised whenever new information is received indicating that the former estimates were wrong.

The laboratory test for sugar-content, and the weather conditions for growing, are the basis for determining when to harvest. Harvesting begins as early as September 15 in some years, while in others it is delayed until October. The harvesting in any locality is affected to some extent by the acreage in beets. Sometimes, when the sugar-content is not satisfactory, it is the duty of the agricultural agent to determine whether or not the beets are mature. Ripeness is indicated by the browning of the lower leaves and the yellowing of the foliage; the leaves also lose their vigor and have a wilted appearance. In making the contract with the farmers, the sugar company reserves the right to say when the beets should be dug. The field agent, therefore, instructs the farmers when to begin digging and makes all necessary arrangements for handling the beets at the way stations. He also gives instruction in the methods of harvesting beets, and especially regarding the topping. Beets are taken to the factory or to the railroad loading stations in wagons. In territories where enough beets are raised to justify the company in building an automatic dump for unloading the beets, one is provided. If no dumps are available, the beets must be thrown from the wagon into cars or into piles on the ground. Hand unloading involves considerable labor and is avoided wherever possible.

Although several methods of handling beets at way stations are in use, one of the most common methods is as follows:

When the farmer arrives at the dump with his load, the wagon and beets are weighed together, and he is given a ticket showing the weight. Several beets of average size are taken from the load as a sample from which to determine sugar-content and purity. He then drives to the dumping place and dumps his load into a hopper. From there the beets go into a revolving screen where most of the dirt is shaken off. This dirt drops on a belt and is carried to a dirt hopper, under which the farmer drives and gets his dirt back; this is taken to the scales

and weighed with the wagon. From 10 to 50 pounds of the beets that have passed over the screen are weighed, and after all dirt is removed, weighed again. From this the percentage of dirt is determined and the net weight of beets calculated.

The problem of ascertaining the proper percentage of tare is one on which there is constant friction, unless both the farmers and the factory are willing to give as well as take. At best, the amount of tare is only an approximation, and every method that can be used to simplify its determination will result in more agreeable relations between the farmer and the sugar company.[1]

When transportation facilities are not available, the beets have to be piled on the ground. Care must be taken, especially in warm weather, to see that they are properly covered in order to prevent evaporation and decay. The piles are built so that ventilation is possible without open exposure to the sun. The same care must be taken in piling the beets at the factory if they have to lie any length of time before they are run through the mill. Special care is given to prevent alternate freezing and thawing, which results in fermentation of the beet and loss in sugar-content. Often unnecessary reloading expense is involved when railroad facilities are inadequate.

As soon as the beets of one season are manufactured into sugar, all employees of the company, except the skeleton organization, are laid off. Two hundred and fifty men working in two shifts of 12 hours each are required to operate the factory. Labor is usually easy to obtain at this season of the year, and many of the persons who work in the brick kiln adjoining the sugar factory take employment with the Leighton Company when the kiln closes in October. The skeleton organization comprises 30 men, including the superintendent and foreman.

As soon as operations cease, the men who remain on the job begin to take apart all the machinery in the factory for the purposes of cleaning and repairing it. The factory is operated continuously after it is once started in October. Any break in the process is expensive, not only because of the delay, but also because sugar which is spoiled in starting must be worked into the process again. An attempt is made, therefore, to operate throughout the season without stopping for repairs. The extent of the repairs, moreover, is determined by the estimated budget which is prepared in July and later revised as more accurate in-

[1] *The Sugar-Beet in America*, F. S. Harris, Ph.D.

formation is received. When the time for starting the factory approaches, the superintendent investigates the plant and takes the necessary steps to see that it will be in condition when the time for starting arrives. Additional men are often employed in advance of the operating season.

Storing the Beets.[1] When the beets are received at the factory, some of them are stored in U-shaped bins at the bottom of which is a flume covered with removable boards. By taking out these boards one at a time, the beets drop into a swift stream of water, which carries them to the factory.

Washing and Weighing. The first step in preparing the beets for the factory is to remove rocks, sand, weeds, and other foreign material that might interfere with slicing. This foreign material is removed by a set of special devices known as the weed catcher, rock catcher, beet wheel, and washer. After the beets are thoroughly cleaned, they are carried by an elevator to the top floor where they are weighed automatically in 1,000-pound dumps.

Slicing and Extraction. The weigher dumps the beets into a hopper from which they go into the knives to be sliced. The chief object sought in slicing is to obtain as large a surface as possible, and at the same time to leave the pieces of beet in such a condition that they will not pack into a mass through which water will not pass readily. Many kinds of slicing knives are used, but all cut the beets into long, thin strips called "cossettes." These are so thin that the sugar contained in the cells of the root can readily diffuse into the water with which the cossettes are treated in the diffusion batteries. The corrugated slicing knives, which revolve rapidly, are able to handle 900 tons of beets a day.

The cossettes pass from the knives to the cells of the diffusion batteries. These are large iron containers arranged in a straight line, cylindrical in shape, and terminating in truncated cones having covers. The series contains 14 cells; each is so connected at the bottom by means of a pipe with the top of the next cell in the series, that a continual flow of warm water passes through the cossettes as long as they remain in the battery. Steam is supplied to keep the temperature in the cells at 80° Centigrade. The cells are so arranged that the container which has had its charge for the longest time receives the fresh water, which removes the last bit of sugar that can be extracted. The pulp from which the sugar has been removed is dumped out and the tank is again filled with fresh cossettes. This tank then becomes the last in the series and receives the water laden with juice after it has passed through all the other cells of the battery.

[1] This description of the process of making sugar from sugar beets is taken for the most part from a book written by Mr. F. S. Harris, Ph.D., *The Sugar Beet in America*, Chapter xviii. Part is quoted verbatim, but changes are made in order to bring in some of the detail and special features of the Leighton plant.

The pulp, or exhausted chips, is conveyed in a stream of water to an adjoining building where it is run through presses to remove as much water as possible without crushing it into a mass. From the presses the pulp is elevated to a conveyor from which it is fed into drums for complete drying. There are baffles in these drums to aid the process and to assist in feeding the chips through the drums more or less regularly. The dried pulp is packed in 100-pound bags to be sold for stock food.

When the juice containing sugar comes from the batteries, it is dark in color and contains in addition to the sugar many impurities which must be removed before the sugar can be made to crystallize. Up to this point, the method of making beet sugar differs completely from that used for cane sugar; beet juice is obtained by diffusion, whereas the cane juice is removed by crushing.

Purification of the Juice. About 3/10 of 1% of the pulp is sugar. If diffusion goes any lower than this, the juice takes in too many impurities. The juice is taken to the carbonation tanks where it is treated with 3% to 4% of caustic lime in the form of thick milk. After thorough agitation, the excess lime is precipitated with carbon dioxide from the lime kiln. The Leighton Company has its own lime kiln where it makes the lime it uses in the process. (The manufacture of this lime will be described later.) The addition of lime is considered the most important operation in the sugar mill and, unless properly done, the final product is affected both in color and amount. The effect of lime on the juice is both chemical and mechanical; the lime unites chemically with a number of substances which would interfere later with the manufacturing process, and it causes many of the solids held in suspension to settle to the bottom; this leaves a clear liquid of light amber color.

When the proper condition in the juice is obtained, it is passed through filter presses to remove the precipitated lime and other solid matter. These solid materials are retained in the frame of the presses. As soon as the frame is full, the lime cake is washed by passing water through it until the sugar content of the cake has been sufficiently reduced. The press is then opened and the cake removed. No satisfactory commercial use has been found for the waste lime, although it is used to some extent as a fertilizer; farmers may come to the factory and haul away free as much of it as they want. A second filtration is made in order to remove any solids that may have gone through the first time. Later the juice is again treated with a little lime and carbon dioxide to reduce further impurities, after which it receives the third filtering.

The juice is now treated with sulphur fumes before it is concentrated, to reduce the alkalinity caused by the lime and to remove additional impurities. The sulphur also has a bleaching action which removes color from the liquid that might be carried on to the sugar. The sulphur fumes are obtained by passing air over burning sulphur. After

being sulphurized, the juice is heated and passed through the filtering presses; it is then ready for evaporation.

Evaporation. During the process of purification, the juice contained a large quantity of water which was used to extract the sugar in the diffusion batteries. This must be evaporated before the sugar will crystallize. The heat required to evaporate water rapidly at ordinarily atmospheric pressure is so high that sugar is likely to be charred. For this reason evaporation is carried on under reduced pressure in order to lower the boiling point of the liquid. Four evaporizers working in a series are used by the Leighton Company. Exhaust steam of from 8 to 10 pounds pressure is used, the arrangement being such that the same steam will cause the juice in all four evaporizers to boil. The juice goes through all four of the evaporizers, entering the first unit at about 20% sugar-content and leaving at about 60%. The steam also enters at the first unit and goes through the tubes into the second unit, thence to the third and fourth units, each boiling at a lower point because each is under a lower atmospheric pressure than the preceding unit. When the juice is taken from the evaporators, it is treated with sulphur again and filtered in the same manner as the thin juice. This is the final process of purification; the juice is then ready for graining.

Graining or Crystallization. The sugar is crystallized out of the condensed juice on large vacuum-pans. These pans have large copper coils through which steam is passed in order to assist the crystallization process. Since the juice has a tendency to darken if it is evaporated under atmospheric pressure, the vacuum-pans are kept under a 25% vacuum with a boiling point at 60° Centigrade. After the juice has been purified properly, there is no difficulty in producing good sugar in this pan. This mixture of crystals and sirup, or "Massacuite," as it is called, is run through a centrifugal machine revolving at a rate of 1,600 to 1,800 revolutions per minute. The sirup is thrown out through fine perforations in the wall of the machine, but the crystals of sugar remain until enough sirup is thrown off to permit crumbling, when they drop out through the bottom of the machine. From the centrifugal machine, the sugar is sent to the driers, commonly called "granulators," where any excess moisture is removed by a current of warm air. The sugar is then packed in 100-pound sacks and 25-pound sacks, four of which are placed in 100-pound jute bags.

The sirup thrown from the centrifugal machine goes to the second vacuum-pan where it is further concentrated and a second yield of sugar, smaller than the first, is taken from it in the centrifugal machine. The molasses which is thrown off is treated with the Steffen process.[1]

[1] "In some of the beet factories the sugar left in the final molasses is extracted by what is known as the Steffen process. The final low-purity molasses is diluted with water and cooled to a very low temperature, after which finely powdered lime is constantly added to the solution at a uniform and slow rate. The sugar combines with the lime and a saccharage of lime is formed which is insoluble

The crystals obtained this time are known as "brown sugar," which is sometimes sold. Ordinarily, however, it is remelted and mixed with new juice after it has been taken from the evaporators. The molasses left after the brown sugar has been removed is a waste product which is sold principally as stock food.

Manufacture of Lime. Large quantities of lime are used to purify the juice before going to the evaporators. The Leighton Company buys coke and calcium carbonate which are heated together in a large mechanical furnace yielding calcium oxide or lime and carbon dioxide. The carbon dioxide, although some escapes into the air, is used in the sugar manufacturing process to carbonate the lime which has been mixed with the juice in the purification process.

The processes are controlled by the laboratory. The beets are weighed as they go into the factory, and by laboratory tests the percentage of sugar is known. The total amount of sugar which should be produced is charged to the factory, and in order to have a check on all steps in the process, laboratory tests are made hourly on the pulp, waste water, lime cake, and the molasses. During an entire season, the loss of sugar is estimated to be as follows:

Loss in pulp	.25 of 1%
Loss in pulp water	.094 of 1%
Loss in lime cake	.107 of 1%
Loss in molasses	3.497%

Since the amount of sugar actually produced is known by the packing department, the unknown loss which may arise from inaccuracies in estimating the amount of sugar which enters the factory or poorly controlled manufacturing may be ascertained. The form on pages 448 and 449 is used by the factory to summarize daily operations. This report enables the superintendent to watch the efficiency of extraction, as well as the efficiency of other operations.

in the liquid. The suspended matter, or saccharate, is then separated and washed in filter presses.

"The cake from these filter presses, which is the saccharate of lime, is mixed with sweet water to a consistency of cream and takes the place of milk of lime in the carbonation process. When the Steffen process is employed, about 90% of the sugar originally in the beet is extracted. The loss of sugar that does take place is accounted for in the exhausted cossettes or pulp, in the pulp water which surrounds them when they are dumped from the diffusion cells, in the cake and wash waters from the carbonation presses, and in the waste and wash waters from the Steffen process."—G. M. Rolph, *Something About Sugar* (1917), pp. 115-16. Reprinted in F. S. Harris' *The Sugar Beet in America* (1919), pp. 265-266.

Daily Operating Report

Factory — Day from ___ a. m. to ___ a. m. — 19___

	Last 24 Hours	To Date	Daily Average	Employees	Day	Night	Total	
Tons Beets Received				Factory				
Tons Beets Sliced				Drier				
Bags Sugar				Yard				
Bags Dried Pulp								

	Last 24 Hours Total Tons	Per Cent on Beets	Per Cent on Sugar Entered	To Date Total Tons	Per Cent on Beets	Per Cent on Sugar Entered
1. Total Sugar Entered						
2. Sugar in Pulp						
3. Sugar in Waste Water						
4. Sugar in Lime Cake						
5. Sugar in Steffens Waste to Sewer or Molasses Produced						
6. Total from Known Losses						
7. Sugar Bagged						
8. Sugar Estimated in Process (Granulated Equivalents)						
9. Sugar Melted (B'ght. or Prev. Camp. Granulated Equivalents)						
10. Net Extraction						
11. Unknown Losses						
Molasses Statement						
12. Sugar in Molasses Produced						
13. Sugar in Molasses Worked in Steffen						
14. Wet Molasses Produced						
15. Wet Molasses Worked in Steffen						
16. Steffen Extraction (12-5 in Per Cent of 12)						
17. Steffen Waste to Sewer Per Cent Wet Molasses Worked						

(Continued from page 448)	Last 24 Hours Total Tons	Per Cent on Beets	Per Cent on Sugar Extracted	To Date Total Tons	Per Cent on Beets	Per Cent on Sugar Extracted
PULP STATEMENT						
18. Dried Pulp Bagged						
19. Pounds Coal to 100 Pounds Dried Pulp Produced						
MATERIAL STATEMENT						
20. Lime Entered in Carbonates (Slacked and Powder)						
21. Total Lime Used						
22. Lime Entering Coolers to 100 Sugar in Molasses Worked						
23. Lime Produced						
24. Waste Per Cent Total Lime Used						
FUEL						
25. Boiler House						
26. Pulp Drier						
27. Potash Fuel Used						
Total						
28. Cold Water Million Gallons						
29. Boiler Feed Water						
30. Lime Rock						
31. Coke Per Cent Rock						
32. Sulphur						
33. Soda to Juices						
34. Total Soda Used						
35. Kieselguhr						
36. Cubic Feet Wash Water Used on Carbonation Presses						
37. Cubic Feet Wash Water Used on Steffen Presses						
38. Pounds Fill per Cubic Foot						
39. Draft Per Ct.						

Form 40: Daily Operating Report

22. THE RANSOME CANDY COMPANY—ACCOUNTING SYSTEM

The Ransome Candy Company manufactures candy, doing a business averaging $800,000 a year. Owing to the competitive conditions in the candy business it is forced to make over 200 varieties of candy. The business is extremely seasonable; during the Christmas and Easter seasons the company does rush work, while during part of the summer it is necessary to close down.

The factory is a six-story building 100 by 80 feet, well ventilated and lighted, owned by the company, and located a mile from the railroad; the Company does its own trucking, owning a small garage and two trucks.

The Ransome Company produces its own power, the charges for power approximating 3% of the total cost of the product. The steam manufactured is used for cooking the candy and for heating the building, for generating electricity, and for refrigeration. The electricity is used for machines in the following processes: cream beating, soft-center making, hard-center making, and machine dipping. It is used in lighting the buildings on dark days and for occasional night work. The building is well planned so that none of the 150 bulbs installed are used except on these occasions. Some refrigeration is used for the soft and hard centers, but most of it is for storing the finished candy. Some grades of candy have to be stored for a period before they are in condition to sell.

Although over 200 varieties of candy are made, many of these are identical in respect of the production time and processes of manufacture, and other varieties are the same in one or more processes. As a result, about 40 varieties may be regarded as representative of the entire output. The processes themselves are only five: cream beating, soft-center making, hard-center making, hand dipping, and machine dipping. Part of the candy is packed in bulk, part in fancy packages.

The general layout of the factory and the approximate amount of space occupied for the various sections are given below:

First Floor		*Second Floor*	
Office	1/12	Machine Dipping	1/2
Power Plant	5/12	Fancy Packing	3/8
Finished Stock Room	1/2	Stores for Fancy Packings	1/8

Third Floor

Hand Dipping (also on sixth floor)	1/4
Chocolate and other Stores for Dipping	1/8
Bulk Packing	5/8

Fourth Floor

Cream Beating	7/32
Soft Centers (also on fifth floor)	3/4
Stores for Cream Beating	1/32

Fifth Floor

Soft Centers (also on fourth floor)	1/4
Hard Centers and Fancy Candies	1/2
Stores for Soft and Hard Centers	1/4

Sixth Floor

Hand Dipping (also on third floor)	1/4
Packing Material Stores	3/4

The above layout shows that stores and supplies in most cases are kept near the department using them. There are certain peculiarities characteristic of the stores in this business which must be considered in planning a satisfactory store system. In the first place, most of the materials have a domestic use and must be guarded against theft. In the second place, the market prices of the materials such as sugar, nuts, and fruits vary from day to day, as well as with the seasons. Particular batches of candy should not be charged with temporary market fluctuations, but batches made in different seasons should bear the seasonal variations. In the third place, many of these materials suffer loss from shrinkage and spoilage when in the storerooms. The shrinkage, though it varies considerably with different stores, may be accurately estimated, and it is essential that different kinds of candy bear their proper share. Spoilage of raw material, however, cannot well be estimated; it may be caused by poor purchasing or faulty storage.

In the cream-beating department the labor is done by two men, paid by the hour. The sugar, condensed milk, and so forth, are cooked on the stove, and the hot syrup is then whipped with electric beaters. The fondant thus made is used only for soft centers, different centers requiring different proportions of fondant. The amount made at any one time must be adjusted to the current demand for soft centers.

The soft center department takes the fondant and the other materials, prepares the pieces for the depositor machine, and enters them in it. Various types of centers occupy the depositor for various lengths of time, depending upon the consistency of the cream and the number of pieces to the pound, and there is

an appreciable expense connected with shutting down the depositor between batches. The labor in this department is paid by the hour.

In the hard center and fancy candy department the materials are mixed and boiled; in addition, some varieties are pulled and cut. The time for mixing and boiling is the same for each batch (within reasonable limits) while the time spent in pulling and cutting varies with the quantity. The labor for mixing and boiling is on an hourly basis; the labor for pulling and cutting is on a piece-rate basis.

The hand-dipping department requires skilled labor which is paid at piece-rates. The chocolate is melted, and the dippers, using special forks, carefully coat the centers and put them on oiled paper. The amount of paper used varies with the weight rather than with the number of pieces coated. Since dipping is a continuous process, the weight of the chocolate coating added to the center cannot be measured directly. However, the amount of spoilage in this department, and of finished chocolates, may be accurately found. Some of the candy is put into molds. The labor for this molding is paid for on an hourly basis.

In the machine-dipping department the work is unskilled. The girls work on the enrobers at an hourly rate. Steam is used for melting the chocolate, and electricity is used for running the dipping machines. Like the hand-dipping department, work is continuous, so the amount of chocolate used cannot be measured directly, but the amount of spoilage can. Here, also, the quantity of oiled paper used varies with the weight of the coated candy, not with the number of pieces.

All the candy is first packed in bulk for storage in the intermediate stores, from which the fancy goods are taken for repacking, some varieties taking more care and time than others. The piece-rates are carefully adjusted for different types of candy. The packers in the packing department are also paid at a piece-rate. A great variety of boxes, ribbons, and fancy papers are used.

In the general office there is an office manager, a bookkeeper, and a stenographer. There are several salesmen, paid on a commission basis. Only the hand-dipped chocolates are advertised. Any cost accounting records recommended must be capable of being handled by the one bookkeeper.

23. THE RANSOME CANDY COMPANY— TREATMENT OF INCOME CHARGES

The introductory section of the "Official Cost Accounting and Cost Finding Plan" of the Midland Club develops the following propositions:

Section I

Fundamental Principles

Before going into the details of the plan of cost accounting and cost finding, it is necessary that all manufacturers have a common understanding of the underlying principles established; the meaning of terms used; and also be advised of the reasons for certain segregations that have been made.

This entire system is built up on the fundamental principles clearly set forth in the chart shown in Figure 41 on page 454.

The entire activities of the business are conducted to produce sales revenue. The chart represents the sales revenue and shows the disposition of that revenue.

It will be noted that there are two prime divisions of the sales revenue, namely: "production cost" and "gross profit." The essential thing is to allocate properly and uniformly all items of cost and expense to these two divisions.

The steps from raw material and its conversion to finished product, its sale and the resulting net profit, are built up in natural chronological sequence. The materials are put together by the productive labor; these two factors constitute prime cost, to which is added the manufacturing expenses (factory overhead) incidental to the process, and the result is the cost of the finished product, the production cost; the end of the first division.

The goods are then sold at the expense of maintaining salesmen (direct selling expense) to which is added the other miscellaneous expenses incident to the sale of merchandise (sales department overhead), and the result is the cost of the goods sold plus the cost of selling them (trading cost).

Out of the proceeds of the sale, the charges against income are provided for (income charges), and what remains is net profit.

These are the natural steps from beginning to end, and this is the way the proposed cost finding and cost accounting system is built up.

In actual practice the cost of an article will be built up to the end of the first division, all of which constitutes the production cost. The producing end of the business stops here. It is entirely disposed of.

The sales department now takes hold. It must produce the gross profit required to leave a satisfactory net profit. A selling price is established by ascertaining the percentage of sales necessary, first, to cover direct sales expense; next, sales department overhead; next, income charges; and finally, the net profit.

The records must be arranged to reveal this necessary information

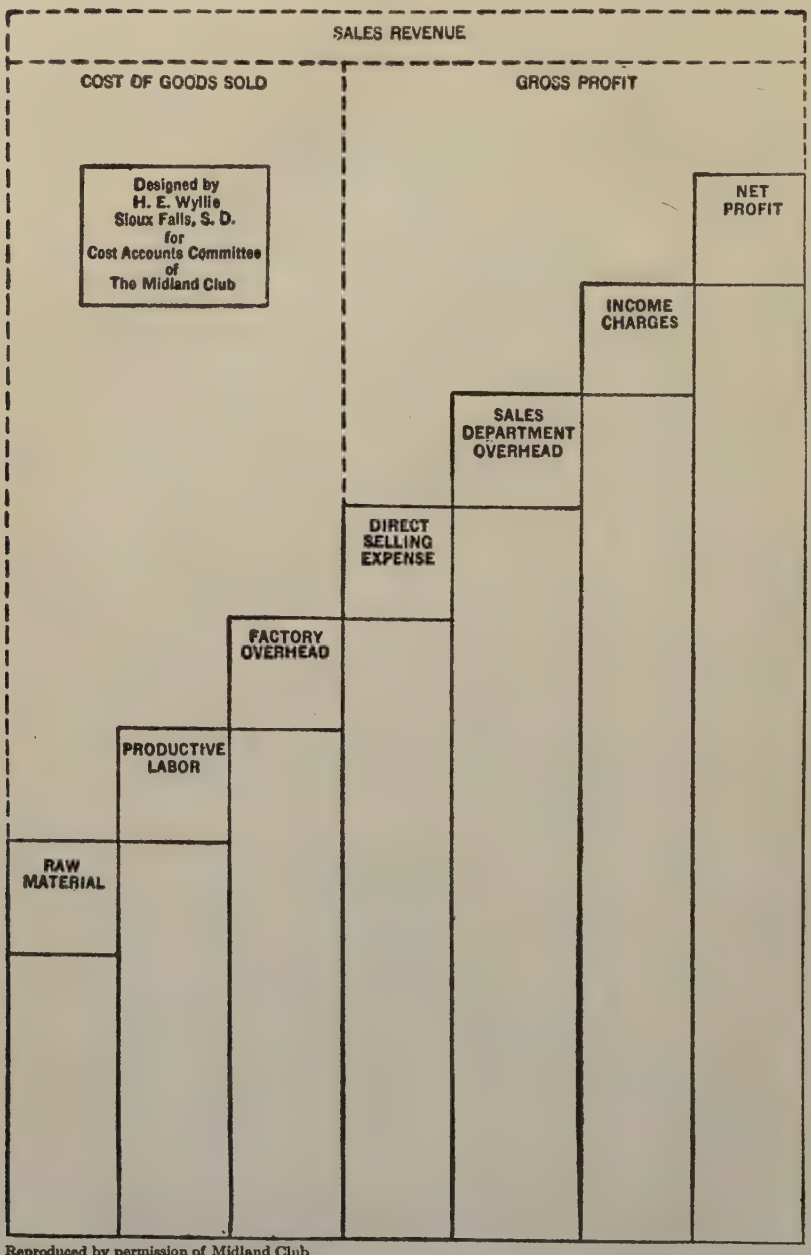


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Figure 41: Chart showing fundamental principles underlying Midland Club's Cost Accounting and Cost Finding Plan

and then it is just a question of using the information at hand in the manner prescribed and the desired results will be obtained.

As an example, the cost sheet shows a piece of goods cost 30 cents per pound to produce. The records reveal the following information:

The direct selling expense is	10 %	of the sales
The sales department overhead is	1½%	of the sales
The income charges amount to	3½%	of the sales
The net profit desired is	10 %	of the sales
Total Gross Profit required	25 %	of the sales

The sale must return sufficient revenue to pay for the production of the goods and still leave 25% of the sale for gross profit. The cost of the goods is 30 cents per pound. Twenty-five per cent of the sale is equivalent to 33-1/3% of the cost. Thirty-three and one-third per cent of 30 equals 10. Ten cents must be added to the cost to determine the selling price. Thirty cents plus 10 cents equals 40 cents, the selling price.

It is recommended that this chart be referred to frequently in connection with all that follows.

Under the heading of "Definitions" the following is contained:

Income charges consist of rent, interest, insurance, taxes, depreciation, cash discount on sales, and bad account losses, and are deducted from the trading profit to determine the net profit.

On account of the importance of this group of expenses, an explanation should be given for this segregation, and the benefits resulting therefrom set forth.

A suggested method of handling these income charges appears in these reasons.

Reasons for Segregating Income Charges

As stated before, the adoption of uniform cost accounting and cost finding methods will avail us little unless such methods are devised primarily to put all manufacturers on a common ground.

The first thing, therefore, that has to be taken into consideration is the different manners in which manufacturers conduct their business. We have to remember that one manufacturer owns his own building, and is sufficiently capitalized to take care of that investment, while another manufacturer does not own his own building, but rents, and is only sufficiently capitalized to take care of manufacturing requirements; one manufacturer may be sufficiently capitalized that he needs to borrow very little money, some of them none at all; while another manufacturer is capitalized to an extent which compels him to borrow heavily; one manufacturer may have long term bonds outstanding, another manufacturer none at all; one manufacturer may carry a heavy stock and heavy insurance, on account of his ideas of doing business; another manufacturer may be located in a central market, and, therefore, carry very little stock and consequently very little insurance; one

manufacturer may have tremendous taxes, another manufacturer may have very low taxes; one manufacturer may have one method of figuring depreciation, another manufacturer another method, a third manufacturer may ignore depreciation entirely. All of these varying conditions have resulted in lack of uniformity in figuring costs; have prevented comparisons of costs. They are the factors that get manufacturers off of a common ground.

The different methods of distributing and apportioning these expenses constitute the most discussed subject in cost accounting, and really are the cause of making the subject of cost accounting a bugbear. This is really entirely unnecessary, and if we will go back to first principles, we will realize that every one of these items of expense —rent, interest, insurance, taxes, depreciation, and so forth—is primarily concerned with the use and conservation of capital, and not with the cost of manufacturing.

A great many people class these expenses as production overhead, and burden down the production cost with them. This is unfair to the manufacturing department; it is impracticable in our judgment; it unnecessarily makes overhead an important factor in cost finding, and they cannot be distributed to various departments or classes of merchandise in an equitable or satisfactory manner, because it must be done on some arbitrary basis, and it prevents comparisons of costs and gross profits by those engaged in the same line of business.

The very nature of these expense items suggests their relation to the use and conservation of capital.

The purpose of any investment of capital is to derive an income. Income is, therefore, "returns" to capital which is employed, no matter what the form of that capital may be. Capital is not necessarily money, but it is spoken of in terms of dollars and cents, because it has a money value. It may be converted into money, or it may earn money for its owner. Anything that produces income, except labor, is capital.

It is manifest that property in the form of real estate and buildings is capital. Rent is paid for the use of property. That rent is "returns" to the owner for the use of his capital by someone else. It is his income. It is "returns" to his capital. If the enterprise that rented this property owned it and, therefore, did not have to rent, they would require just as much more capital in their business as this property would cost. In this case their enterprise would have to earn just as much for them as it did when they rented. There would be just as much income required to satisfy the capital employed.

This same argument is equally true of interest. If an enterprise did not borrow capital they would require just that much more of their own capital invested in the business.

What difference does the ownership of the capital make? Because one bunch of capital is represented by shares of stock, another by bonds, and another by a lease, and another by a note, does it alter the fact that "returns" to capital is income? Are not rent and interest,

therefore, in the same category as dividends? They are all alike. They are income from the use of capital in different forms and taking different names to distinguish the nature of the investment from which such income is derived.

If you own 100 shares of stock in a concern, and it pays a 7% dividend, that corporation charges that 7% against the earnings of the business, or, in other words, against the income of capital invested.

If you also own the building the said concern occupies, and they pay you rent for it, and you also loan them money and they pay you interest for it, is there any rhyme or reason for the corporation to charge these items against production cost, and the dividends against the earnings? These items have no bearing on the cost of production. The fact that part of the capital being used is represented by a lease and part of it by shares of stock and part of it by a note, does not add one cent to the cost of manufacture. Therefore, it is maintained that rent and interest are not proper charges to production overhead and production cost.

Now there are certain expenses incurred in the ownership of capital. Expense in keeping it intact, in conserving it. Your capital is protected by your government and this expense is called taxes.

You provide against the possible impairment of your capital by fire, water, tornado, personal injury claims, and so forth, and this expense is called insurance.

You provide against the impairment of your capital through wear and tear, through obsolescence, through inadequacy, and this expense is called depreciation.

It doesn't cost you one cent more to manufacture a piece of goods when you make these provisions than when you don't. But if you don't make these provisions, you may some day have a lot less capital.

If, for example, a stock of wax paper burns up, has that added anything to the cost of candy? No—it has simply reduced the owner's capital unless he was insured.

Inasmuch as capital produces income, what is more logical than to charge the expense of maintaining it against the returns that it produces?

It is maintained, therefore, that these expense items are improper charges to the manufacturing and selling departments, because they are purely and distinctly incurred to protect and conserve capital. They are, therefore, proper charges to only one account, and that is income.

It is not intended to deny that these expenses are part of the cost of operating the business as a whole; it is simply contended that they are not factors of production cost.

The contention, based on logic, has been made that rent, interest, taxes, insurance, and depreciation are concerned with capital and not with costs, and, therefore, should be set up as a group chargeable against income. But there is a further reason for doing this. By keeping these items out of cost you do not lose the value of cost com-

parisons—one period with another—one department with another—one article with another.

The world progresses "by comparison" and we should make efforts to arrange our records so that comparisons may be made and really mean something to us.

Supposing one year you rent or borrow money or do both, and you charge rent and interest to the cost of manufacture. And the next year you increase your capital and occupy your own building and don't have to borrow. You have lost the value of all comparisons, and your cost figures are going to show that it cost you more to manufacture when renting and borrowing than under the new arrangements. But did it? You used the same amount of capital in both cases; the difference is that in one case you paid rent and interest for the use of it, and in the other case you paid dividends for the use of it.

Under the new financial arrangements your cost of manufacturing will show a decrease, if you had previously charged these items to production cost. If you reduce your selling price accordingly, how are you going to pay dividends on the increased capital invested?

By the segregation of these items of expense, which have been grouped under the title "Income Charges," we dispense entirely with the necessity of distributing them over the various departments in the business, and dispense with the necessity of attempting to apportion a share of them to each article on which we are figuring costs. It is absolutely impossible to devise an equitable method of distributing these expenses to departments, or to particular products. By segregating these charges and taking them out of costs entirely, all manufacturers, no matter what their plan of operation is, can be put on common ground. It will make no difference whether they rent, or own their own buildings; whether they borrow money, or don't borrow money. It will make no difference where they are located, they can figure their costs and compare them, and each will have a thorough understanding of what the other means when he speaks of his Gross Profits.

The Ransome Candy Company is in process of installing a cost accounting system. For this purpose it has made a study of the Cost Finding Plan of the Midland Club, but is uncertain about accepting the above recommendations relating to "Income Charges." The Ransome Company is disposed to charge them to manufacturing overhead in the usual way.

24. THE CHOCOLATE AND COCOA INDUSTRY—ACCOUNTING SYSTEM

The manufacturing processes of the chocolate and cocoa industry are described as follows by George Rea, in the *Official Publications of the National Association of Cost Accountants.*[1]

[1] Vol. III, No. 20, July 15, 1922.

The quality of the finished product depends to a large degree upon the respective proportion of the several kinds of beans taken into the mixture. Perpetual inventories and frequent verifications are accordingly necessary to assure the management that the production records are correct and that the high quality of the finished product is being maintained.

Since prices fluctuate sharply, the stock records show not only the quantities of the various grades but the prices at which the several lots were acquired. These prices, of course, include all charges up to the time the lot is delivered to the storeroom or warehouse. Warehousing, hauling from warehouse to factory, and price fluctuations are elements which make a standard cost system essential in order to be able to measure the efficiency of the purchasing department.

Sugar is ordinarily bought from the American refiner and presents no special problem in purchase and stores accounting. The chocolate manufacturer can keep his sugar stores record in the same form as that for his cocoa beans.

Other materials used in lesser quantities will be mentioned again in connection with their processing. It might be stated here, however, that aside from stores control in order to assure accurate production records, they have no special importance in costing.

Preparatory Processes. The manufacturing processes are of two general kinds: the first, the preparation of the raw materials, and the second, the blending into finished or semi-finished food products.

The preparatory processes are cleaning, roasting, cooling, and cracking the cocoa beans, and pulverizing the sugar. All of these operations are done by machinery with a minimum of labor.

The cleaning machine removes sticks, stones, dust, and other dirt. Records of the quantity of refuse removed, which are not always kept, however, are valuable guides to the purchasing department. The cleaner and roaster are usually connected, the cleaned beans being automatically conveyed from one machine to the other. The roaster contains a revolving cylinder suspended over a fire, in which the beans are heated to a temperature of 260° to 280° Fahrenheit to drive off the moisture and accentuate the natural flavor.

The roasted beans are removed from the roaster into broad, shallow pans with perforated bottoms where they are cooled, the process being hastened by an induced draft. The cooled beans are shoveled into the hoppers of a machine which cracks them between steel rollers and separates the hulls and cocoa dust from the nibs. The nibs are the broken pieces of the body of the bean containing the essential food elements. The hulls are the thin shells of the bean having no value in the industry, but having been used to good account as fertilizer and as cattle food when pulverized. Cocoa dust is the fine particle of the body of the bean containing only 18% of vegetable oil which is less than the government standard. If there were a greater demand for cocoa, the dust probably could be made marketable by increasing

slightly its oil content. It is sometimes added to an equal weight of nibs in order to make a low-grade chocolate product. In the cost accounts it is given no value as a by-product, nor is it taken up as of any value if added to the low grade mixtures, since it only contributes to the loss in process.

As the preparatory processes are practically continuous operations, and the labor expense is small, process costs are practicable. Yet the beans are put through in lots, so lot costs can be obtained as readily if desired.

In a small factory handling seven or eight tons of beans a day, the total manufacturing expense in the roasting department (which is the name sometimes given to the preparatory processes) will be less than 50 cents per hundred pounds of nibs produced. The same equipment and labor can easily handle up to 10 tons of beans per day, with a consequent reduction in department cost to approximately 30 cents per hundred pounds of nibs. This condition suggests the advantages of standards which show the excess cost of subnormal production.

The standard rate is stated in cents per hundred pounds for labor, for machine expense, for supplies including fuel for the roaster, and for fixed charges, respectively. The total amount earned by the department in any period, which is ascertained by applying these rates to the number of pounds of nibs produced, is taken up in the cost of the product, and the balance of the cost of operation is charged to burden variance and to unearned burden. No adjustment need be made either with standard or with process costs for possible differences in time required to roast and crack the different grades, since these differences are negligible.

The loss of 20% in moisture, shells and dust in the preparatory processes must be taken up in the material cost by adding 25% to the standard cost of the bean. Any variation from this percentage, which is accepted as standard by the trade in predetermining selling prices, is carried to a fluctuation account.

Theoretically, the weights should be checked after each operation. But every practical purpose is served by comparing the weight of the nibs with that of the beans put into process. A reasonable approximation of the loss with that of previous runs of the same grade of bean is an assurance of proper handling and accurate accounting.

Pulverizing Sugar. In order to make a smooth chocolate, the sugar which constitutes from one-third to one-half of the mixture must be pulverized. Granulated sugar is bought from the refinery and reduced to powder in a mill. Its cost in the mixture is the cost of the granulated sugar plus the labor, expense and burden of the sugar mill.

In the small factory with a single mill where the operator can spend a part of his time on other work, the expense of pulverizing is not important enough to warrant a special segregation, and therefore it is included with that of the roasting department. For process costs, the total expense of the department divided by the weight of nibs and pulverized sugar produced is the unit cost to be applied to both

nibs and sugar. If standard costs are used, one standard may be set for the department, or a special rate may be determined for pulverizing, based upon time studies made in the sugar mill.

Grinding. In the first process after the preparatory processes described, the nibs are pulverized in a grinder, which melts the vegetable oil content by the heat engendered by friction. There is about 55% of vegetable oil in the nibs which is enough to carry the fibrous matter and ash in suspension and to make the product of the mill a smooth liquid of the consistency of molasses. The trade name of this product is liquor, and of the grinder, liquor mill.

Liquor is the basic ingredient of all chocolate and cocoa products. The various grades of liquor bear the names of the kind of beans from which they are made. They are mixed in proportions according to their quality and flavor to produce different grades of chocolates and chocolate products.

The liquor flows from the mills into 100-pound cans. The number of cans of liquor is a ready check on the product from a given quantity of nibs. Greater accuracy by weighing is impracticable except in a very large factory because of the liquor adhering to the can, the cost of scraping out the contents in order to get an exact weight offsetting any possible inaccuracy from under-filling. A good foreman can estimate the production of liquor very closely.

A more important problem is the careful handling of liquor. In order to have it available for mixing, it must be made in excess of immediate requirements, the surplus being left in the cans and set aside until required in the mixing department. Careless workmen will not keep the grades apart. No direct loss results therefrom, but the mixing reports of liquor used do not agree with production and inventories. The quality of the chocolate product may be affected by mixing liquor not called for by the formula. If such a condition develops or is suspected, a daily count of the cans of liquor of each grade on hand and a reconciliation with the liquor-mill and mixing reports should be made until the quality of the chocolate reaches the standard again.

The liquor is also an article of commerce, being sold to confectioners who make mixtures according to their own formulae, but who do not have the equipment for roasting, cracking and grinding the beans. For this trade the liquor is drawn into shallow pans, each holding 10 pounds and carried to a cooling chamber (called the ice box) where at a temperature of 40° Fahrenheit it hardens and is readily wrapped and packed.

For the trade a mixed liquor is occasionally made by mixing nibs of two or more grades before they are ground.

The cost of liquor is the cost of the nibs plus the liquor mill expense, including fixed charges and labor, and, if it is sold, plus also the cost of wrappers and packing. In this case standard costs can be used to advantage, only production statistics being required, thus eliminating the volume of lot cost computations.

The liquor mill is not infrequently considered a part of the roasting or preparatory department of the small factory, in which case its costs are included in the standards previously mentioned for that department.

Cocoa Butter and Cocoa. The materials, the preparation of which has been described, namely, liquor and pulverized sugar, are mixed with milk and flavoring extracts to make chocolate. Before taking up the mixing operations, however, another process must be described. This is the production of cocoa butter which is added to many chocolate mixtures to give them an easy working consistency and a balanced food value. Cocoa butter is the natural vegetable oil extracted from liquor, the process leaving a by-product, cocoa powder. These products are more conveniently termed butter and powder, respectively.

The liquor, having been left at or brought to a temperature above its melting point, 90° Fahrenheit, is pumped under high pressure into a filter press which extracts nearly 75% of the vegetable oil (butter) content. The butter as it comes from the press is ready for the chocolate mixture, but the powder, which is the fiber base of the bean now containing about 22% to 24% of vegetable oil, is subject to additional processing before it is ready as a beverage for the market.

The fibrous matter left after the butter is extracted is not soluble in water. Accordingly, notwithstanding that it was finely reduced in the liquor mills, it must be yet more finely pulverized in order that it may be readily taken up by the water in which it is steeped. The hard cakes of powder (so-called) taken from the filter press are first broken up in a roll-crusher. A pulverizing mill directly connected to a fine wire-mesh sifter completes the reduction, the coarser particles retained by the sifter being returned to the pulverizer for further processing.

The powdered cocoa is packed either by hand or by machinery in containers of from ¼ lb. to 100 lbs. each. Accurate weight and a low packing cost are desirable, which primarily are problems of management, but accounting records must supplement the vigilance of the foreman and superintendent. The weight of the powder (in cake form) taken from the filter press, must be accurately reported as a check on the packing room reports. To maintain efficiency, low costs and reliable stores records, the quantity packed and time consumed may be ascertained by the method described in the section of this article, "Packing Chocolate Bars" on page 465.

Two distinct problems arise in costing cocoa. The first one is to apportion the cost of the liquor between the butter and powder extracted therefrom. The second one is the costing of the processes by which the powder is prepared for the trade. The latter is simple, involving no unusual procedure, and it may be done either by the lot or the process method, the latter giving as equally reliable results as the former and with much less expense. Standards can also be used to advantage for both the manufacturing and packing operations.

Mixing. Let us consider again the main product, having arrived

at the process where the raw and prepared materials are mixed in kneading machines according to formulae.

The finished product is of two general classes, coverings or coatings and confections. There are many grades of each. Coverings are sold to candy-makers and confectioners who make chocolate-covered candies or candies with a chocolate base. Confections, for the purpose of this article, comprise only the well-known chocolate bars and nut bars, as it is not desired to discuss the more complex candy products. Both coverings and confections pass through the same processes in the mixing department.

The materials employed, it will be remembered, are liquor, pulverized sugar, cocoa-butter, milk and flavoring extracts. The lot of materials placed in the kneading machine is called a batch. The quantity in a batch varies with the formula, from 450 pounds to 600 pounds. The mixer reports daily the number of batches mixed to each formula. In the cost department the batch totals are converted into quantities of materials which are checked against stores withdrawals and against production reports of liquor and pulverized sugar adjusted for inventories. When there is doubt of the accuracy of the mixtures, as for example when the finished product is not up to the standard, a daily check is made until normal conditions are restored.

In the kneading machines the materials are thoroughly blended. The mixture is then delivered to the finishing machines where it passes around and between rapidly revolving, smooth steel cylinders which incorporate the ingredients and give the compound a smooth finish. The highest grades are worked about five times as long as the cheapest, and other grades for relatively shorter periods.

If process costs are obtained on a per-pound basis, the time required to finish the several grades must be taken into consideration. From time studies, a series of decimal equivalents of the respective finishing times is computed. The total process cost is apportioned to the several grades produced during the month upon the basis of the quantity of each multiplied by its decimal time-factor. The cost thus apportioned to any grade, divided by the weight of the product of that grade, gives the cost of finishing per pound.

For cost purposes the mixing and finishing processes may be combined into one if desired, a decimal equivalent being obtained for the total mixing and finishing time, and the total department cost apportioned by the method just described.

The mixture comes out of the finishing machines as a smooth paste and it is immediately placed in mixing tanks, where it is raised to a temperature of 110° Fahrenheit and more cocoa-butter is added according to prescribed formulae. At this stage broken chocolate from the packing room is put back into process, care being taken, of course, to combine paste and broken chocolate of the same formula. The quantity of butter and broken chocolate added in the mixing kettles is reported daily. Slowly revolving paddles blend the ingredients into a thick liquid. If the paste is a covering mixture the contents of the

tank are drawn through a spout at the bottom, fitted with a valve, into shallow pans containing 1, 5, or 10 pounds each and carried into the ice box, which is a large room kept at a low temperature by refrigerating apparatus. At 40° the contents of a 10-pound can will become solid in about 45 minutes, after which it is broken out by laborers striking the upturned pan smartly on a table. The cakes are loosely covered with paper and packed in cases containing 100 pounds. Cakes broken in handling either in breaking out or packing, are returned to the mixing department and put back into process as previously described.

Process costing can be employed to much better advantage than to attempt to follow a batch or series of batches through the department. The time element is unimportant and need not be considered except in the finishing process as previously described. In the smaller factories, mixing, finishing, ice box, and packing are considered as a continuous process. As relatively more laborers are employed in the ice box and in packing, though the total number employed in the small factory (of six to eight tons daily production) is small, mixing and finishing may be taken as one process and ice box and packing as another. In large factories, more subdivisions will be found necessary.

A monthly recapitulation of daily reports of chocolate packed and of broken chocolate adjusted by inventories, compared with the mixing reports, assures the accuracy of the production records on which costs are based. If discrepancies cannot be accounted for a daily accumulation by grades provides data from which test comparisons may be made at frequent intervals, either at the end of a run on a particular grade or by the aid of in-process inventories.

Broken chocolate is valued at the cost of finished chocolate less packing expense. It is charged back into process at the cost of the materials in the mixture to which it is added. The difference between its finished cost and the in-process value is the loss resulting from breakage. Periodical reports of quantities and resultant losses by grades should be submitted to the management.

Molding. The mixtures from which chocolate bars and nut bars are made pass through the same operations as those described for coverings up to the point where the liquid paste is ready to be drawn from the mixing tank. Instead of being drawn into pans, the paste is conveyed to molding machines. These machines automatically and rapidly place the molds in position, fill them with the paste, remove the surplus paste and eject them on to a conveyer which carries them to the ice box. The mold is a flat metal plate, ¾ inch or more in thickness, with recesses the size and shape of the desired chocolate bar. The number of recesses in a mold depends upon the size of the bar. A mold may hold up to five pounds of paste.

To mold nut bars, a machine has been devised with an additional hopper to contain nuts. The machine feeds both paste and nuts to the mold. In a factory not equipped with this special machine the

nuts are mixed by hand in a container into which the paste is drawn from the mixing tank.

Besides the operator, the machine requires an attendant to keep it supplied with molds and paste. In the small factory, it is the only machine which requires the constant attention of the operator. In this case, therefore, the labor cost is of relatively greater importance. If desired, time records can be kept of the run on each grade and on each size and style of bar. Process costs can be obtained as readily, however, by the method described for the finishing machines, because the molding machines fill the molds at the same rate for all sizes and styles of bars. The weight of the chocolate in each mold multiplied by the number of molds filled per hour or minute gives the quantity molded. It is a simple matter, then, to apportion the cost for the period upon the basis of the quantity of each style of mold and the hourly rate of molding. Or, standard costs may be set which when applied to the product will give the standard cost of operating the department for the period. The excess of actual over the standard cost of operation is the cost of lost time and inefficiency which unless controlled may easily become excessive.

The bars harden in the ice box, and are then readily broken out of the molds and placed loosely in tote boxes in layers, with oiled paper between the layers, and carried to the packing room.

Packing Chocolate Bars. In the packing department the bars are wrapped and packed in cartons. Both operations can be done either by machinery or by hand. Machines are more generally used in the larger factories. The time which the small factory loses in making the many changes required to adapt the machines to a different style of bar absorbs a large part of the labor saving which otherwise would justify the investment. If machines are used, time records can be made, or process or standard costs can be computed with the weight of the bar and the number wrapped or packed per hour as the basis, as described for molding costs.

Hand packing, though done by cheap labor, may easily become expensive. The foreman must be alert to see that the girls are constantly supplied with bars and with packing material so that idle time expense may not be incurred. But dependence must be placed upon reliable cost data to insure a fair day's work from the girl if she is paid by the hour or day; to insure just and reasonable piece-work rates if they are in effect; or to insure adequate production records for bonus, premium or differential rate wage systems.

It is more difficult to secure adequate production data in the small factory because the girls are changed frequently from one class of work to another. When a girl may complete her job within an hour, it is almost impossible to compile exact cost data that will justify the expense. Excessive variations between employees on the same class of work are the rule, yet the excess costs thus incurred are too small, because of the low wage-rates, to warrant the expense of other than the most simple cost system.

If either lot or class costs are to be obtained for day-rate workers, a simple method is to collect the wrapped or packed product at regular intervals, and record on each girl's card the quantity taken away, class of work done and time to the nearest quarter hour. To prevent alterations, the amount is also punched from a series of numbers printed on the margin of the card. A new card is issued daily.

In the cost department the elapsed time on each class of work is entered, and the total time on the card is compared with the clock record. Then the rate of pay is entered and the costs extended. The number of pieces wrapped or packed and the cost for each class of work are posted to summary sheets, and weekly or monthly totals accumulated. This affords a ready comparison of the quantities reported daily as wrapped and as packed, which of course should agree. The quantity packed can also be compared with the deliveries to the storeroom. Thus reasonable accuracy may be insured. The month's totals must be adjusted to the quantities taken into stores, which, of course, must be reconciled with the weight of material put in process less broken chocolate. This method insures a reasonable distribution of the packer's time, and may be employed to very good advantage, when only the total cost of wrapping and packing each style of bar is wanted. For the small factory, it could hardly be recommended as a reliable record of individual efficiency or a basis for piece-rate or a bonus or premium plan, but the larger factory which can afford the expense of a higher-priced employee to collect the production data, would find this method satisfactory.

Excellent results are obtained by setting standards for wrapping and packing. From a comparison of the total cost of each class of work with the standards, the small factory can determine whether it is advisable or necessary to make a more detailed comparison or whether to apply pressure through the superintendent and foreman to increase efficiency. The larger factory can supplement the comparison of totals by a comparison of individual production.

Packing materials are an important element of cost because of excessive waste unless closely controlled. These materials are tin-foil wrappers, oil-paper wrappers, print-paper wrappers, labels, cartons, carton liners and cardboard fillers, and interliners. These vary with the style of the bar, but the quantity of each, per bar or carton, is always the same for any style. From the production records, therefore, the cost of wrapping and packing materials used is readily computed. The excess of the cost of materials drawn over the material used is the loss by waste. As comparison is made for each item, continued loss in any article will be noted and investigations disclose whether the fault is owing to the employee or the quality of the material.

The Cost System. Of the total manufacturing cost, only 10% to 12% is labor and 12% to 15% is burden, as compared with 70% to 75% for materials. The possible saving to be effected by the use of an intricate system making exhaustive analyses of manufacturing ex-

pense is relatively so small as to render such a system impracticable except for the largest establishments. Accordingly, process costs are to be preferred to lot costs because they require less detail and fewer computations.

The foundation for a process cost system will be found in nearly every factory in the daily material reports, which are essential, not only to insure proper accounting for materials, but also to control the quality of the finished product. These reports can be readily adapted to the requirements of a process cost system. A survey of the establishment should be made to ascertain what operations can be combined into one process, to the best advantage, for cost purposes. More combinations can be made in the smaller plants, but the division of the factory into departments and the combination of operations into processes for cost purposes will be determined largely by the facilities for reporting production and weighing the materials at points where they may be diverted into more than one operation or grade of product.

Simple forms for daily reports must be used, for the factory personnel is not of a high order. Equally simple columnar forms to accumulate the production data and to distribute expenses to departments and processes, and a concise yet comprehensive form of monthly report of operations showing results in pounds and values complete the accounting records.

The cost accountant must not be content to deal only with monthly totals. The responsibility for the accuracy of the records and costs rests upon him alone. Therefore he must assure himself that the daily reports which he receives are correct. He can easily follow in his records a run on any grade of beans, even of several days' duration, through the cleaner, roaster, cracker and liquor mills and see that the quantity of liquor made bears a reasonable relation to the weight of beans drawn from stores. The number of batches can be readily converted into liquor put into mixtures, which, deducted from the inventory at the first of the month plus production, leaves the quantity that should be on hand. Test inventories of finished product may be made as readily. To the conscientious cost accountant with a lively interest in his responsibilities, his cost work will be as satisfying as the product of the factory.

Give a list of cost ledger accounts which would be suitable for the records required by a plant similar to that described above.

Selecting out of the above list of accounts those which represent processes, fill in the debits and credits with detailed items and figures in such a way as to indicate their use and content.

Describe the production reports, giving a form for them, which you would recommend for the purpose of keeping control of this factory, and also to serve as the basis for accounting records.

25. CONSOLIDATED BISCUIT COMPANY—ESTIMATING SYSTEMS OF COST ACCOUNTING

In considering the installation of a cost accounting system, the Consolidated Biscuit Company, a newly formed corporation, learned that one of its large competitors used an estimating system involving only one form (Form 42, between pages 468 and 469) and requiring only one cost man at each factory. This system was not tied in with the general books of accounting, but involved ascertaining by a monthly test the cost of each kind of biscuit manufactured.

On the form the materials used in a half-day's actual run for one kind of biscuit at their standard unit prices at the factory and in total were listed; the materials for the filling, topping, or icing were listed in the same way and added to the cost of the materials in the biscuit proper to find the total cost of the raw material. Next, the material used to pack the biscuits was noted, together with the price per unit and amount. From the time-tickets the direct labor involved in making the run of biscuits was ascertained. Since there were sixteen similar ovens, the overhead per oven-hour was computed by taking the overhead expenses for the previous three months and dividing them by the normal number of oven hours. The overhead rate was multiplied by the time taken for the run to find the burden chargeable to the batch. The total of the material, labor, and overhead gave the complete cost of goods ready for shipment. The production at list price was compared, on the reverse side of the form, with the cost to determine the gross profit on sales at list.

Another competitor had a complete cost system by which the costs of every batch made were ascertained and compared with the yield. In order to keep the different branches on a comparable basis, all raw materials were charged to them by the home office at standard costs. Frequent reports were forwarded to the home office, where a book inventory of materials sent to each branch was kept. All direct labor was charged to the batch on which it was expended. Since the ovens operated by this company were not of uniform capacity, each oven was used as a production center for the distribution of overhead. All items of burden were allocated to the ovens in what seemed to be the

most equitable way, on a space basis, on a direct labor basis, or according to the investment in the individual ovens.

This system enabled the home office to make accurate comparisons of output between factories for each type of oven. Waste and loss of raw materials were kept under strict control. The home office left little to the discretion of the branch manager, because the records received enabled it to advise in detail as to practically every move to be made. The system had operated smoothly, and the accounting costs were not large, although they exceeded the amount necessary for the competitor's estimating system.

Which of these two systems, if either, should have been introduced by the Consolidated Biscuit Company?

26. THE DELIGHT FLOUR MILLS COMPANY—ACCOUNTING SYSTEM FOR A FLOUR MILL

The Delight Flour Mills Company of St. Paul operates seven small mills, one of which is located in St. Paul, and the others scattered throughout Minnesota and North and South Dakota. In addition, it also owns and operates a line of elevators through which it purchases most of the wheat used in its milling operations.

Purchase of Wheat. The wheat purchased from farmers is received at the elevators and mill doors in wagon loads. If the farmer sells the wheat immediately, he is paid by a draft drawn on a local bank; but often he prefers to store it until the market becomes more favorable. In the latter case the elevator or mill issues a storage receipt good for 10 days, at the end of which time, the farmer must either sell, store, or remove his grain. If he stores it, he is given a warehouse receipt in exchange for the storage receipt previously issued; with this as security he can borrow money from a bank or from the company. When the wheat is finally sold the warehouse receipt is surrendered for a draft drawn on a local bank, and a transfer is made on the books of the Delight Company from storage to purchases.

The elevators dispose of the wheat either by shipping to the mills or by selling on the terminal market in Minneapolis or Chicago. In the transactions between the elevators and the mills, the elevators are treated as separate organizations. Ship-

ments, which must be reconciled with receipts at the elevators, are made as soon as a car can be filled. All wheat received at the mills must be accounted for in the milling operations. The stock reconciliation records are made in both quantity and values, wheat in bushels or pounds, and flour in barrels (196 pounds), or, in the case of milling in transit,[1] in pounds.

Milling in Transit. All tonnage received to be milled in transit must be shipped out before the lapse of six months. If the mill at New Prague, Minnesota, received a carload of wheat weighing 50,000 pounds to be milled in transit, an individual record of this shipment must be kept, showing its origin. Freight on the shipment must be paid from the point of origin to New Prague at the time the shipment was received. Any time during the six months following, shipments of flour or feed may be applied against this poundage of wheat to be milled in transit. It is not necessary for the correct percentage of flour and feed to be applied against any one shipment. If the mill had a chance to apply 50,000 pounds of feed against this shipment, it would be within the regulations of the railroad to do so. The traffic manager must know from which points of origin he can obtain advantageous freight rates on flour and feed milled in transit.

If shipments of flour or feed are to be made to Boston, the freight is calculated from the point or origin of the shipment of wheat to Boston. Since the freight charge from the point of origin to the mill was paid when the wheat was received, this amount is refunded when the total freight charge for the shipment from the point of origin to Boston is paid, or what amounts to the same thing, the difference between the amount already paid and the total freight charges from the point of origin to Boston is paid.

When wheat is received at the mills, it is dumped in pits and elevated to the working floors of the elevator. The wheat is analyzed according to protein or gluten content with no relation to the test weight or moisture content, and allotted to bins on the working floor, each of which holds one carload. This method of grading differs from the market classification which designates wheat by grades according to the weight of the berry, the uniformity in size and color, and the

[1] All the mills, with the exception of the one in St. Paul, do a large quantity of milling in transit. The mills receive the wheat, grind it into flour and feed, and then ship it to a destination on through freight rates. The rules for milling in transit are specifically described in the tariff schedules of the railroads.

moisture content. The foreign seeds or screenings that are present in the wheat are known as "dockage." The weight of these foreign seeds which is ascertained from a sample by testing sieves, is deducted proportionately from the weight of grain received, the payment being based upon the clean wheat.

Wheat Blending. At the beginning of a milling season [1] an arbitrary basis for protein content is set for the wheat mixture to be ground. Because the milling quality of wheat varies each year, this protein content is determined from the early receipts of new wheat on the market. Since the milling rolls must be adjusted according to the quality of wheat, the milling mixture should be as uniform as possible in order that a uniform flour may be produced.

The wheat is mixed to the proper milling blend when it is taken from the bins on the working floor and stored in the milling bins which hold about 50,000 bushels each. Not all the wheat, however, is blended from the working bins. Wheat of high protein content is put in storage and used later in preparing the proper milling blend. Most milling companies buy as much wheat of good milling quality as they can store when the crops are moving, in order to produce as uniform a quality of flour as possible. The risk of loss from large inventories is eliminated by hedging.[2]

Wheat Cleaning. When the wheat is taken from the elevator, it goes to the grain cleaning department where all foreign matter is removed and the wheat made ready for milling. One of the most common machines in use is known as the Zig-Zag Separator, which takes its name from the arrangement of the sieves which carry the wheat backward and forward, while it is being fanned. All dust, chaff, smut balls, light wheat, and other light materials, are removed by the first aspiration. The first sieve is made of screening large enough to let the wheat drop through while the peas, beans, oats, barley, and other large substances "tail over" the sieve as "screen-

[1] Milling season refers to the crop season. Whenever a new crop is received, a new milling season is said to have begun, and for this reason the fiscal year of most flour milling companies is from August 1 to July 31.

[2] If it were possible to purchase the quality of grain desired on the market at any time, it would be a simple matter to protect all sales of flour by purchasing the exact quantity of wheat required. Unfortunately, however, a milling company cannot depend on the market to furnish it with the exact quality of wheat required. It is customary, therefore, for the large mills to purchase as much high quality grain as they can store when the crops are moving in the fall. This wheat can be blended later with a poor quality of wheat, which can be purchased on the market as required, to make a mixture which will produce a uniform flour. In order to protect itself on the high quality wheat which it must carry, a milling company resorts to hedging.

If a mill contracts to deliver 100,000 barrels of flour two months hence, it may not own the wheat which it will use in milling that flour at the time of taking the contract. In setting the price for the flour, the company will use the prevailing price of "spot" wheat as a basis. If the price should advance as much as one cent a bushel before the wheat for that contract was purchased, the company

ings."[1] The second screen, made of perforated zinc, has perforations large enough for the sand, mustard, and other round seeds to fall through, but small enough for the wheat to tail over the sieve for a second aspiration which removes the chaff and other material that has been loosened from the grain since the previous aspiration.

The next process varies in almost every mill. Sometimes the wheat has to be run through special machinery to remove mustard seed and cockle, but this process is similar to the cleaning to which the wheat has already been subjected, except that no air is used. The processes are purely mechanical and usually consist of eliminating certain seeds by means of horizontal cylinders indented on the inside. For instance, if cockle is to be eliminated, the grain is run through the cylinder while it is revolving, the cockle rolling into the small indents and lifted above a tray before it falls. The indents are not large enough for a wheat kernel unless it stands on end; the wheat, therefore, rolls back beneath the tray while the cockle falls on it. The barley cylinder is arranged in the reverse order, the wheat being lifted above the tray and the barley going beneath it. There are many degrees of fineness in the cleaning of wheat, some mills using more processes than others. Ordinarily, however, the millers look upon the wheat cleaning process as a continuous one which could not be broken up for purposes of accounting.

The wheat is next weighed in an automatic scale as it goes to a scourer to be prepared for milling. The scourer is a perforated iron cylinder through which runs a shaft carrying beaters revolving at a high rate of speed which rub the wheat against the inside of the cylinder. The impurities scoured off the wheat pass through long perforations in the cylinder which are too narrow for the wheat. A large fan draws the dirt from the grain as the wheat enters the scouring cylinder. The fanning separates the dirt which has been loosened from the wheat, the smut and beard (commonly called "bees wing"), and part of the first cut of bran. The wheat, which now has a polished appearance, next passes into a washer which removes any adhering dirt and dissolves lumps of dirt which passed through with the wheat. Any stones, which have remained with the wheat up to this point, are separated by falling to the bottom of the washer while the wheat floats.

would lose $4,700 (assuming 4.7 bushels of wheat are required to grind one barrel of flour), an amount which would reduce the profits substantially, and if the price should advance five cents a bushel, it would probably wipe out the profits entirely. Of course, there is an even chance over a short period that the price of wheat may go either up or down, but it is this risk that a milling company wants to avoid. This it can do by purchasing futures for the amount of wheat necessary to fill the contract. Then, when the company buys the actual grain, it can sell futures to cover its purchase. As a result of these operations, the loss on the flour contract, in case the price of wheat advanced, would be offset by the gain on the futures, or vice versa in case the spot price declined.

[1] "Screenings" are the foreign seeds, broken wheat, and chaff removed in cleaning wheat, after the coarse refuse has been discarded. The oats are usually separated and sold as "Mill Oats." Screenings are used to feed sheep and, when ground finely, are sometimes used to make mixed feed for cattle.

Wheat Tempering. The wheat then goes to tempering bins, where more water is added to condition it for the grinding process. The tempering bins of the Delight Company are 4 feet square and about 30 feet deep, with a movable hopper equipped so that it can be used on any one of the tempering bins. Wheat is tempered to secure an even moisture content, as it is now understod that the mellowing of the grain is of more importance than toughening the outer cover or bran. The wheat is left in these bins 72 hours, although other mills take a shorter period for the tempering process; still others keep their wheat in the tempering bins as long as possible without allowing the wheat to germinate. An effort is made to have the wheat go to the rolls with a 15% moisture content. Since the tempering process requires 72 hours the capacity of the tempering tanks must be large enough to keep the mill running at capacity for three days. As wheat goes out at the bottom of the bins, more wheat goes in at the top, the water being fed by the moving wheat on automatic valves.

The wheat is scoured a second time after it is taken from the tempering bins. This scouring which is not as severe as the first one, takes off some of the bran and any of the "bees wing" which may remain. It is then put through a second tempering process, which lasts about eight hours, in order to make the moisture content uniform. The water is fed into this bin automatically by the action of the falling wheat.

After the second tempering, the wheat is scoured for the third time, this scouring being still less severe than the second. In this process the wheat is run in mass into the cylinder which whirls around, rubbing the wheat against itself and the rough sides of the cylinders. After the third scouring, the wheat is taken to the milling rolls.

The Milling Process. Milling is a continuous process. Uniform quality, which depends upon uniform operation of the machines, can only be insured by treating all the milling equipment as a unit, starting and stopping at the same time. The "streams" of all mill products flow automatically from one machine to another, being used from the time the wheat enters the mill until the flour and feed run into the bins. The volume of these streams is not apparent until one becomes interrupted or choked up. Some streams run as high as 250 barrels or 50,000 pounds per hour. In case of any irregularity, as in first starting up, the flour must be put in special bins and remilled to make sure that the quality of the flour that goes to the packer is of uniformly high standard.

The aim of all millers is to fracture the wheat without flouring it on the first break. The break rolls are grooved from end to end with flutes shaped like saw teeth. The grooves are slightly spiral, being cut at an angle of about 15 degrees to the axis of the roll, so that they do not interlock with the grooves on the other roll of the pair, in order to afford a shearing action. The difference in the speed of the two rolls, known as the differential, gives the necessary grind-

ing. The depth of the grooves on the rolls determines to a large extent the size of the particles of middlings which are separated immediately from the bran after each break by a machine known as a "bolter" and then sent to the purifiers.

Sifting. The bolter is a sifting machine, containing many sieves covered with wire or silk bolting cloth,[1] by which the product coming from the grinding rolls is sifted or separated according to fineness, and made ready for further treatment on purifiers and other grinding rolls. A bolter resembles a vertical cylinder suspended from the ceiling by flexible wooden rods at four corners. The whole body of the cylinder is shaken rapidly by means of a revolving crank shaft passing through the center of the cylinder and driven from above. The sieves are "pie-shape," 12 sieves making a complete circle; these sieves are held in the frame one tier above another, 30 tiers giving 360 sieves. Stock or middlings to be sifted is spouted into the top of the cylinder at several points through flexible cotton tubes, called "stockings." The outer shell of the cylinder consists of 12 doors with double walls which form vertical passageways permitting the stock, when finished on one set of sieves, to go to another set lower down or to leave the machine at the bottom through flexible stockings. The purpose of the large number of siftings is to graduate the flour particles into as many streams as possible according to the size or degree of fineness of the particles.

The Purifiers. There are a series of bolting machines which correspond to each series of grinding machines. After each grinding, the break stock is taken to the bolters, from which the coarse stock is returned to the next series of grinding machines, while the wheat middlings or flour are spouted to machines known as purifiers. These machines separate the fine particles of grain or feed from the middlings and remove the coarse white particles from the inside of the wheat berry. A suction fan draws air through an inclined sieve which is shaken rapidly. This sieve, over which the middlings travel, is a graduated series of silk cloths separating the middlings into several sizes, which fall into funnels underneath, and in some mills produce as many as 20 different streams of patent flour.[2] The current or air is regulated so as to cause the particles of feed or "bees wing" to flow along until they tail over the end. Although these particles are ground to the same fineness as the middlings, the difference in weight makes this separation possible. The purified middlings are returned to the rolls for grinding into flour, and the light particles are ground

[1] Sifting is done by means of wire cloth in some cases and by silk bolting cloth in others. Break stock is sifted on a wire cloth because the coarse heavy particles would wear silk quickly. Wire cloth in this coarse size is cheaper, as well as more durable than silk which is used for sifting fine middlings and flour. Silk is cheaper than wire cloth in the fine size and does not corrode or clog as does wire cloth.

[2] Patent flour is a trade name used to designate flour made by this process, since the purifier is a patented machine.

for feed. The rolls on which the middlings are ground, however, are smooth instead of corrugated.

The modern system of flour milling may be described as a process of gradual reduction. Every pair of rollers or grinding machine reduces the particles of wheat a little, and separations are made between the reductions, the partly ground stock going to another set of rollers and the finished flour being sent to the purifiers. This system of flour milling is known as the break system. There are from five to six successive breaks in the Delight Mills, although many mills use more or fewer grindings. The more times the wheat is ground the more finely it can be graded on the purifiers. Finished flour, therefore, emerges at many points, instead of all at one final point.

When the flour has been reduced to the desired fineness and graduated into streams, it is taken to a horizontal conveyor which feeds the packing bins. The only difference between baker and family flour is in the blending of the different streams of flour, baker flour having more gluten than family flour. The bakeries can handle the sticky dough resulting from flour having a high gluten content, because the mixing is all done by power-driven machinery. Patent flour which is blended into several grades sometimes includes a percentage of first-clear flour.[1]

The flour is mixed in the horizontal endless worm conveyors which take the various streams from the mill spouts to the packing bins. The mill is constructed so that some streams may be diverted to any one of the three or four conveyors according to the grade of flour being blended.

Packing Flour. Flour is packed in various kinds of containers. Wooden flour barrels have been superseded by cotton and jute sacks and paper in the smaller sizes because of the greater economy in the cost of sacks, the greater facility in handling by modern convey-

[1] Other grades of flour and feed produced are as follows:

(a) First Clear Flour is a second-grade flour regularly produced in the patent process. It was originally called "First Baker's," but this name was considered to be a misnomer, because bakers appreciated and purchased the best flour manufactured. The name, "First Clear Flour," was agreed upon by leading millers many years ago and has been universally adopted to designate this grade.

(b) Second Clear Flour is the lowest grade of flour used for human consumption, regularly produced in the patent process. It is dark in color and used extensively in the export business, as is the First Clear Flour. All grades of flour, whether Patent, First Clear, or Second Clear, are sold under established company brands as well as private brands.

(c) "Red Dog" designates a finely ground grade of feed which has the appearance of a dark flour and consists of the finest particles of the outer coverings of the wheat berry. The name is said to have originated from a picture of the British Lion appearing in red colors on bags used for packing feed in early days. This product also is called Adrian flour.

(d) "Standard Middlings" or "Shorts" designates the grade of feed containing the finer particles of "offal" which is next in coarseness to bran. The name is used in the United States to refer particularly to that feed from which the low grade flow of Red Dog has been removed. The name is used by the trade as one of several grades of feed middlings. The trade, however, is beginning to dis-

ing methods, the compact piling of sacks reducing storage and shipping space required, the greater usefulness of empty sacks as compared with barrels, and the modern tendency to buy in smaller packages because of improved retail distribution. Barrels still are used for some New England trade and for export to the West Indies, South America, and Africa, and also by some steamship lines for commissary use where adverse climatic conditions seem to favor the wooden barrel. Fifty-pound square tins, which may be soldered water tight, are used by the Navy.

A flour packer is located directly under the flour bin. A hopper permits the flour to flow into a tube, which is of the right size to go into the barrel or sack, which is raised upon a carriage. The tube contains a revolving auger which compresses the flour and forces the carriage down a fixed distance until the required amount of flour is obtained. Then a trigger releases the barrel; the auger stops; and the carriage descends so that the sack can be removed and weighed by hand, on a scale placed beside the packing machine, before being sewed. Since a slight error, multiplied by the thousands of packages produced, would represent a large loss, exact weight is required by the mill on each sack. The platform, on which the small packages rest while being weighed, is a grill through which any flour that is spilled falls into an apron.

Bran is packed directly from the milling machines, because it tends to block the bin by arching across from side to side.

Subsidiary Processes. Many machines used in the flour milling process are more or less side issues of the main process, but are convenient and economical to use. The automatic dust collector, designed to cover a large amount of surface in a small space, filters the air and extracts the dust particles. The air which goes through the purifiers and other machines is blown into a cylindrical drum, the surface of which is perforated with holes about two inches in diameter which serve as openings to cloth tubes. The air is filtered through the cloth and returned to the room, while the dust remains in the tubes. The tubes are supported in a frame which revolves periodically,

tinguish more generally between the various grades of feed. It is common now to see market quotations for "flour middlings," which is a mixture of standard middlings and second clear flour.

(e) Bran is the coarse outer covering of the wheat berry which grinding and sifting separate from the flour and the finer grades of feed. It is used mainly for animal feeding, particularly in dairying. Its bulk tends to restrict shipment, confining its consumption more to the locality of the mill than is the case with flour.

(f) "Straight" flour is a combination of the mill run of patent flour, first clear, and second clear flour. It is 100% of the flour produced, and is the longest possible patent. It is often called a "100% patent," although it contains a part that is not patent flour.

The term "short patent" refers to the percentage or ratio which the amount of patent flour bears to the total amount of flour produced, including patent, first clear, and second clear flours. A skilful miller not only wishes to make a good extraction, but also wishes to make as high a percentage of patent flour as possible. A "short patent" flour means a smaller percentage of the total flour streams than a "long patent" which represents the most skilful milling.

bringing each row of tubes directly over a conveyor into which the dust is knocked by a pair of automatic hammers. This action keeps the collector clean and in continuous operation.

Another such machine is the bran duster which removes the low grade flour adhering to the bran before it is finished and packed as feed. A vertical, cylindrical wire screen contains a revolving brush which throws the bran against the screen and brushes off any flour. During the war many mills were compelled to install bran dusters to make the required economical extraction of flour [1] from the wheat they were allowed to use. The larger mills have always used them as a part of their regular equipment.

In going through a mill producing 6,000 barrels of flour daily, visitors frequently do not see an employee. Manufacturing labor is a small element; most of the employees of the Delight Company are engaged in selling.[2]

Analysis of Costs. The amount charged to the production of feed is identical with the market price. The Delight Company determines the monthly average selling price of each kind of feed, multiplies it by the quantity of each produced during the month, and credits the manufacturing account with the total. The relative cost of preparing the grain for milling, milling the wheat, and packing and loading the flour depends upon the volume of business. Figures for the Delight Mills for 1921-1922 were as follows:

	Mill Number 1
Preparing the grain for milling	5 cents
Milling the wheat	29 cents
Packing and loading	7 cents
	41 cents

The number of persons employed at the mills varies with the capacity of each mill. One of the mills of the Delight Company, which produces 500 barrels daily on a 24-hour basis, em-

[1] "Extraction" means the percentage of flour produced, or the number of pounds of flour obtained, by grinding 100 pounds of wheat. During the war, Government regulations required an extraction of 74%, or 74 pounds of flour out of every 100 pounds of wheat. A barrel of flour of 196 pounds thus required 264.8 pounds of wheat, or 4.316 bushels. Extraction figures can be obtained by dividing 196 pounds by the yield expressed in pounds, figuring a bushel at 60 pounds.

"Yield," which is the measure of milling results, is the number of bushels or pounds of wheat required per barrel of flour (196 pounds). The better the wheat and the higher the skill of the miller, the lower this figure will be, and, in milling parlance, the better will be the yield, and the higher the extraction of flour.

[2] The following figures taken from *Report of the Federal Trade Commission on Commercial Wheat Flour Milling*, September 15, 1920, p. 90. (*Continued on next page.*)

ploys 16 men working in two shifts. At each mill there is a head miller responsible for all the processes of the mill, for the output, for the grades of flour produced, and for its general welfare. In addition to thorough trade knowledge such a man must have mechanical and executive ability. The head miller is assisted by a second miller who oversees all the processes in cleaning, grinding, and bolting. He plans the work, trains new men, works with the chemist in determining the yield of flour and feed, and is in full charge in the absence of the head miller.

Other Operations. A chemist analyzes the wheat and the various streams of flour and other mill products, except where the mill is too small to justify this amount of specialization. In such cases the testing is ordinarily done by the second miller or the head miller.

The elevator foreman is responsible for the acceptance of wheat into the elevator. He inspects the wheat for correct grade and directs the storage according to the grade and the protein content. He keeps a record of receipts of wheat, tests, weights, and the disposition of the various lots. From one to four assistants are employed according to the size of the mill and elevator.

The man in charge of preparing the wheat for grinding is

Footnote continued from preceding page:

ANALYSIS OF THE COSTS OF THE 37 COMPANIES IN MAKING AND SELLING A BARREL OF WHEAT FLOUR, BY YEARS, 1913-14 TO 1917-18.

Item of Cost	1913–14	1914–15	1915–16	1916–17	1917–18
Wheat	$3.96	$5.42	$5.09	$8.32	$ 9.72
Packages	.27	.23	.24	.31	.47
Mill operating costs	.22	.22	.21	.28	.37
General and selling expense	.30	.33	.31	.42	.41
Total cost of flour and feed	$4.75	$6.20	$5.85	$9.33	$10.97
Charged to production of feed	.76	.84	.77	1.26	1.29
Net cost of flour per barrel *	$3.99	$5.36	$5.08	$8.07	$ 9.68
Mill operating costs:					
Mill labor, power, and miscellaneous operating costs	$0.17	$0.17	$0.16	$0.22	$ 0.28
Repairs	.02	.02	.02	.03	.06
Depreciation †	.03	.03	.03	.03	.03
Total	$0.22	$0.22	$0.21	$0.28	$ 0.37
Total operating, general and selling costs ‡	$0.52	$0.55	$0.52	$0.70	$ 0.78

* Based on barrels of flour produced.
† Actual figures, 0.0316.
‡ These costs do not include interest charges, which amounted to 2 cents in 1914, 3 cents in 1915, 2 cents in 1916, 5 cents in 1917, and 4 cents in 1918.

known as a "smutter." In the larger mills, he has an assistant who sometimes divides his time between the elevator and the grain cleaning department. The smutter also supervises the work of the sweepers, oilers, and general help on the floors when the mill is large enough to warrant their employment.

The grinder sets the machine for grinding, and tests the stock carefully to make sure that it is being ground properly. He works in close cooperation with the bolter, who supervises the sifting machines, and adjusts the feed slides so that the machines are not overfilled. The bolter makes a comparison between the flour he is making and the accepted standard to determine whether any variations in color or specks occur which may be due to particles of feed getting through some hole in a silk bolting cloth. When a sample of each has been placed side by side they are dipped in water and baked, in order to accentuate the color comparison and to preserve the record as long as may be required.

Samples are taken at regular intervals and sent to the laboratory in Minneapolis for comparison with the standard and for chemical analysis. A bakery is maintained at the Minneapolis office where a loaf of bread is baked daily from each grade of flour manufactured in each mill. The same recipe is used for each loaf so that accurate comparison is afforded with standards baked under the same conditions. The equipment and methods used are similar to those used regularly by bakers. Flour produced by competitive mills is compared in this laboratory with flour produced by the Delight Company.

In the larger mills the blender mixes the different grades of wheat flour and flour from coarse grains in designated proportions. In the smaller mills, however, the blending is usually done by the second miller.

A packing foreman, with two to four assistants, has charge of the packing. In the small mills the bolter and grinder assist in packing flour; this accounts for the small number of employees required to operate the 500-barrel mill. In this mill the loading is done by the same men who pack the flour, but in the larger mills a special loading crew of two to four men is employed.

A millwright department, employing from two to six men, also is maintained in each mill; it is responsible for the upkeep of the mill in general, and for repairing all trouble with the

spouting, milling machinery, and equipment. This department, under the direction of the head miller, repairs, installs, or removes machinery and equipment for spouting. When a large amount of work is to be done at one of the mills, the employees in the millwright department of other mills are transferred temporarily.

Closely allied with the millwright department, but independent of it, is a man known as the roll tender, who is responsible for the cleanliness of the machinery, the lubrication of bearings and beltings, the filling of all oil and grease cups about the milling rolls, and who reports any mechanical trouble to the miller, or the millwright department. In the smaller mills, the grinder does the work of the roll tender.

The larger mills maintain a special storehouse in charge of a storekeeper where all sacks and other supplies are kept; in the smaller mills, however, all the employees are made responsible for keeping the records of supplies and sacks.

E. TEXTILES

27. THE GREYSON FINISHING COMPANY—ACCOUNTING SYSTEM

The Greyson Finishing Company finishes both yarns and grey goods according to the orders of the converters with whom they deal. The converters buy grey unfinished cloth and yarn, and have it bleached, mercerized, printed, or otherwise treated, in the finishing plant. Since the Greyson Finishing Company does not own such cloth or yarn, its charges are based on the processes through which the material goes. Converters usually store large amounts of cloth and yarn in the finishing plant, awaiting converting orders, and the finished goods are shipped directly from the finishing plant to the converters' customers. Since finishing orders are likely to be seasonal, the plant has a difficult problem of utilizing its mill during the slack periods and of turning out orders with sufficient speed during rush seasons. As the company is obliged to keep valuable machines which are used only occasionally, it also has a difficult problem in distributing overhead charges and determining normal costs. The management of the company, therefore, wishes to install an accounting system which will provide a basis for charging the

various types of finishing done on the different materials which it handles.

The departments in the plant are as follows:

1. Grey Room
2. Singe House
3. Mercerizing Room
4. Bleaching and Washing Department
5. Dry Room
6. Winding Room
7. Cotton Dyehouse
8. Silk Dyehouse
9. Print Room
   a. Engraving Department
   b. Color Shop
10. Soapers
11. Steamers and Agers
12. Rope Soapers
13. Cotton Tenter Room
14. Silk Tenter Room
15. Calender Room
16. Folding and Inspecting Room
17. Packing Room
18. Shipping and Receiving Room
19. White Stock Room

1. *Grey Room.* In the grey room the bales, which contain approximately 3,000 yards, or 25 double cuts [1] of 120 yards each, are opened and the ends of the pieces sewed together in a continuous chain of 10,000 to 60,000 yards. On the end of each piece is marked the number of the order and the roll number.

2. *Singe House.* The cloth is next sent to the singeing house where it is passed rapidly over a gas jet in order to remove the nap, or fuzz. It is then run through a pot-eye, a piece of hard rubber about eight inches in diameter, which twists the cloth together into a rope form. It is then run down through a mixture of diastafore and water in order to take off any sparks adhering to the cloth. This mixture also aids in the fermentation of any size in the cloth and makes it easier to be removed.[2]

3. *Mercerizing Room.* Mercerizing consists of running cloth through

[1] A double cut of cloth, 120 yards, is a convenient length for the women inspectors in a cotton mill to handle.

[2] Grey cloth as it comes from the cotton mill is a light greyish brown color which is due to natural impurities remaining in the cloth, to any dirt which may have been picked up in the process of weaving, and also to the size which is put into the warp for the purpose of protecting it during the weaving process. Before the cloth is bleached it is necessary to remove some of the impurities. This is done by boiling the cloth in a kier (a large metal container capable of holding about 3,500 to 4,500 pounds of cloth), which contains a weak solution of caustic soda and water, and a little soda ash and soap. This boiling off process is carried on for approximately seven hours under pressure. A cloth containing silk must be treated in the preliminary stage in a slightly different process than that containing only cotton, because the action of caustic soda on silk is destructive. A cloth containing silk cannot be boiled in a kier, but must be wet out in hot water.

a weak solution of caustic soda and water under tension in order to give it a silky lustre. After the cloth is "boiled off" to remove the impurities and thoroughly wetted, it is stretched on a frame. The purpose of keeping the cloth under tension during the process is to prevent it from shrinking through the action of the caustic soda on cotton. After the mercerizing process is finished, the cloth is washed in hot water to remove the remaining caustic. It is then ready to be bleached along with the cotton cloth that has not been mercerized.

4. *Bleaching and Washing Department.* In this department the cloth is kier boiled, washed, and bleached. It is then ready for the bleaching process proper, which is done in a solution of chlorine gas. The cloth is run through this solution, allowed to stand in it approximately 45 minutes, and then, after it is washed off in a solution of sulphuric acid, it is given a final wash in water. It is then stored in bins until ready for drying.

5. *Dry Room.* The cloth is spread out to its full width and dried by being passed over metal cans about 24 inches in diameter which are heated with live steam. After being passed over the dry cans, it is pleated into boxes and inspected for bad seams, picks, tears, and other defects. At this stage the cloth is divided into rolls of approximately 1,000-yard pieces.

6. *Winding Room.* The cloth is next sent to the winding room where it is wound on wooden rollers on which the order number is marked; then it is stored until it is ready for dyeing.

7 and 8. *Cotton and Silk Dyehouses.* A certain amount of cloth is not printed, but is sent out after being dyed in the cotton dyehouse. The balance of the cloth which goes through the cotton dyehouse is dyed with a color which will receive the printing. Dyeing consists of dipping the cotton cloth into a solution of hot water and dyestuff. This immersion process is carried on until the required shade is produced. Certain common shades which are known to the dyer, such as navy blue and copenhagen, can be produced at the first attempt, but other difficult and new shades sometimes require four or five immersions. Before the cloth is dyed it is again "wet out" in the dyehouse. This consists of running the cloth through hot water, in order to insure an even shade. After the cloth is dyed, it is dried on cans, in the dyehouse, which are similar to those described in the dry room.

There are various methods of finishing cloth. The two principal subdivisions of pattern are termed white grounds and dyed grounds. Cloth termed "white grounds" is not dyed previous to printing; the pattern is printed directly on the white cloth. Cloth termed "dyed grounds" is dyed in the silk or cotton dyehouse; the pattern then is printed on these colored or "dyed grounds."

All silk must be dyed in a separate department. It is first boiled out in soap and hot water to remove the natural gum and size and then washed in hot water. The dyeing process is similar to that used in the cotton department with the exception of a few distinctive silk

colors. The cloth is afterwards dried on cans similar to those used in the cotton dyehouse.

9. *Print Room.*[1] (a) Printing of textiles consists of placing the pattern on cloth by means of engraved copper rollers. Each color of the on cloth by means of engraved copper rollers. Each color of the pattern is engraved on a separate roller; if a pattern contains blue and pink colors, there are two copper rollers, one containing the blue design, and the other the pink design. The cloth is passed over a cylinder which varies in diameter from 3 to 10 feet, depending upon the number of rollers necessary to print the pattern. The rollers necessary for the pattern are placed in bearings around the cylinder and run in a wooden box containing the color. The cloth, after being passed between the cylinder and the rollers, is dried on cans which are a part of the same machine.

(b) *Engraving Department.* Although all patterns in a printing shop are owned by the converters, the finishing plant owns the copper rollers. The converter in New York gets the patterns, or designs, from a designer who attempts to foretell the coming styles and colors from season to season. When the design is completed, it is sent to the finishing plant where it is engraved on copper rollers about six inches in diameter. As described above, one copper roller is engraved for each color contained in the design. The customer has the exclusive right to the use of this pattern, since he has paid for the cost of engraving it. At the end of the season, or when the pattern is obsolete, the design is machined off and the copper rollers are ready for a new design. One of the functions of the finishing plant is to engrave these copper rollers and to hold them in storage for future use. The process in the engraving department consists first of design making. As soon as the design is made, it is cut in zinc by hand and is then transferred to the wax-covered copper rollers by means of a pantograph machine. This machine has a number of diamond points which are operated by a master point which traces the lines of engraving on the zinc. The roller is scratched with the pattern and then placed in a pit of acid which cuts into the copper where the wax is scratched off. After the wax is washed off, the roller is polished and put away until required.

(c) *Color Shop.* The color shop is an auxiliary department to the printing room. No processing is done in this department, but the color for the printing room is boiled up, mixed, and sampled. The color used for printing consists of a mixture of starch, dextrin, and gums of various descriptions which are necessary to give body to the color.

10. *Soapers.* The soapers fix the colors, brighten them and remove the thickening material. In the case of basic colors the tannin color lake, formed during steaming, is not sufficiently fast; hence, the addi-

[1] Some of this dyed cloth is not printed, but is finished directly.

tional treatment with an antimony compound is necessary to complete the fixation, the antimony entering into combination with the tannin color lake and forming a double lake which is of commercially good fastness to wash. In addition to the fixation of basic colors, others such as vat colors can be conveniently fixed in these machines, but the subsequent washings are not sufficiently vigorous for shirtings. For the bulk of the printed work fixation and washing are best done in the open soaper, which consists of a series of compartments (6 or 7) placed end to end, each carrying a number of rolls over which the cloth is carried and provided with squeeze rolls between each box, all driven by chains and sprockets. The first box contains the fixing material; the remaining boxes are fitted for washing the cloth with hot or cold water or soap in order to effect the removal of as much as possible of the thickening materials and the superfluous color. Fixing and washing with water is sufficient for much of the work, but for heavy colors and blotches a treatment with hot soap is advantageous and often necessary.

11. *Steamers and Agers.* (a) The object of steaming is to effect the fixation of the coloring matter on the cloth by the chemical reaction of certain materials in the printing pastes.

In the case of basic colors the printing paste is made of a proper thickening material to which is added the solution of dyestuff and tannin in the presence of acetic acid; the acetic acid is added to prevent the premature formation of the insoluble color lake. During the process of steaming the acetic acid is driven off and the coloring matter and tannin then combine to form the insoluble color lake.

Chrome colors, during the steaming process, combine with the metallic mordant (chrome) which develops the color and fixes it in the fibre. With most colors of this class the action of the continuous steamer is sufficient to bring about a satisfactory development of the color, but some dyestuffs are not sufficiently developed under the conditions of temperature obtainable in the continuous machine. In this case it is better to use the Cottage Steamer, although this method entails more handling of the goods.

The fixation of pigment colors is brought about by the coagulation of the albumen present in the color paste; the insoluble coagulated albumen holds the pigment color on the cloth mechanically. Since a short steaming treatment is sufficient to bring about the coagulation, this style can be run in the agers.

Anilin Blacks are produced by the oxidation of anilin salt in a mixture of chlorate and ferrocyanide of potash or soda under suitable conditions of heat, moisture, and the presence of air.

On the other hand, the vat colors, or so-called "fast colors," are fixed on the cloth by steaming in a container as free from air as possible, during which process the color is reduced to the leuco form (i. e. colorless) and fixed on the cloth.

(b) *The Continuous Steamer* consists of a long chamber through which the cloth passes, hanging from rods in loops; the steam is intro-

duced through perforated pipes in the bottom of the steamer, and the temperature maintained by steam coils along the sides of the chamber. The rods carrying the cloth are slowly pushed forward by a plunger; the end of the rods travel in parallel tracks situated near the top of the chamber.

The rods are fed into the machine at the front and discharged at the back. The cloth (1 to 6 ends) is drawn continuously by draw rolls into the machine through an aperture on the top of the steamer a short distance in advance of the bottom of the chute holding the rods. On account of its weight the cloth forms a loop gradually increasing in length. The rods advance at a speed so timed that when the cloth has formed a loop about 16 feet in length, another rod is pushed against it, taking it slightly beyond the point where the cloth entered and forming a new loop. When the cloth arrives at the extreme end of the machine, it is drawn out by rolls, the separated ends being plaited down by cutlers.

The machine is speeded so that the goods remain in the steam chamber 35 minutes, and are delivered at the rate of 20 yards a minute.

(c) *The Cottage Steamer* consists of a circular iron chamber, one end of which is closed by a door which can be tightened with hand screws to withstand steam pressure from the inside. The goods, after being first wound up in full cuts, are hung on wooden rods carried by a framework which runs on a track into the steamer. One end of each rod fits into the center of a gear, the gears intermeshing in such a manner that by the operation of a wheel from the outside of the steamer, the rods can be simultaneously turned and uneven results are avoided which would occur if the position of the cloth on the rods were not changed.

When the framework is filled with the pieces for steaming, it is covered with a blanket to prevent drops from steam condensation, and then pushed into the steamer, which is securely closed by the handscrews. It is customary to introduce the steam through a layer of water on the bottom of the steamer in order to increase the moisture in the steam. A pressure of four pounds should be sufficient to produce a temperature of about 225 degrees F. The length of time which is usually necessary for the complete development of the colors under the above conditions is 30 minutes. The steam is then shut off, the pressure is released, and the goods are run out. The pieces are then wound off into a truck, sewed together, and washed.

The principle of the agers is to submit the goods to the action of steam (without pressure) either with or without air, for a period of about four minutes; the pieces pass through the machine continuously. Inside the steaming chamber are arranged two rows of rollers, one at the top and the other at the bottom. The cloth passes over these rollers, going into and coming out of the machines through a slot at the top. The delivery end passes from the rollers at the back of the machine over the top rollers and out. The steam is introduced through

a perforated pipe under a false bottom. The chamber is heated by means of steam coils along the sides and by plates along the top.

The Anilin Black Ager differs from the other agers in which fast color discharges are run, since it is provided with a vent and fan at the back of the machine which draws air and steam through the chamber. The only outlet in the "fast color ager" is the slot through which the goods pass in and out.

12. *Rope Soaping Department.* Certain styles of color, such as fast color shirting, must be run through the rope soaping department in order to give them a more thorough washing. The process of washing in the rope soaping department takes longer, and stronger chemicals are used than in the soapers. Other processes carried on in the rope soaping department are washing, soaping, and can drying.

13. *Cotton Tenter Room.* The cloth is stretched in the tenter room to its required width and also sized or back-filled according to the requirements of the customers. The frames, which are similar to those in the mercerizing department, are the principal machinery in this department. At the receiving end of each frame there is a mangle which consists of two rolls 8 to 10 inches in diameter; one is rubber and the other is wood covered with cloth. One of these rolls runs in a rectangular box containing the size or back-filler mixture which is forced into the cloth as it passes between these two rolls. Different kinds of cloth require different mixtures; for instance, organdie has a stiff, hard, starchy mixture; nainsook has a soft mixture; imitation gingham is given a mixture which will take a high luster when it is calendered. Some kinds of cheaper cloth are loaded or back-filled with a mixture of clay and size, to give them the appearance of a superior quality cloth. After being sized, the cloth is stretched, dried, and wound on rolls again.

14. *Silk Tenter Room.* This department contains similar machinery to the cotton tenter department, but since silk takes a slightly different process, it is usually run under different conditions as to size, heat, and tension.

15. *Calender Room.* A stack of calenders consists of a number of heavy steel and cotton rolls set up on top of each other on a frame. The cloth is run through these calenders until the required finish is obtained. Certain classes of work require a slight pattern which is engraved on a hollow steam-heated calender roll. When applied to the cloth the heat softens it slightly and allows the pattern to be impressed upon it. This is known as Schreiner Calendering.

16. *Folding and Inspecting Room.* Previous to inspection the cloth is pulled off the rollers and yarded off into 60-yard lengths, which is about the maximum the workers can conveniently handle. It is then folded and inspected by women who throw out all imperfections, such as tears, breaks, and marks. After the inspection it is cut into lengths as required by the customer, and either wound on boards or sent away

folded. In either case, it is marked with the customer's label, tied, and wrapped with paper. It is then ready for the packing room.

17. *Packing Room.* There is no processing done in the packing room. The cloth is simply packed into cases as prescribed by the converter. One of the functions of the finishing plant is preparing the cloth for delivery to a great many customers. The converter who, with his office in New York City, is not in a position to store or handle the finished cloth, sends his orders from his customers to the finishing plant which packs and ships them.

18. *Shipping and Receiving Room.* In this room cases are labeled according to instructions from the converter, and shipped.

19. *White Stock Room.* This is a stockroom for bleached cloth either ready for shipment or for further processing and finishing.

The two main seasons in the finishing business are summer and winter. In the summer the principal business is on light colors and floral patterns on white cloths. In the winter the trade runs to dyed cloth, voiles, dress goods, imitation ginghams, cretonnes, curtain cloths, and the like. The samples for the winter trade are sent out about June or July and the orders begin to come in from the converters about the last of August. It takes approximately six weeks to print an order of cloth and approximately three weeks to finish an order of plain cloth. The finishing charges[1] are on a yardage basis; the smallest charge is for bleaching only and the highest charge is for printing and dyeing. The amount of the charge varies according to the number of colors, the kind of color, the method of putting up, the difficulty with which the coloring material is obtained, and the size of the order. The minimum order accepted is approximately 10,000 yards, although the range is from 10,000

[1] The finishing plant does not own the cloth which it processes. It is simply the agent of the converters and stores the cloth until converters' orders are received. It is, therefore, responsible for the safety of this cloth, both while it is in storage and while it is in process. If the finishing plant damages cloth in process, it is liable for the value of the grey cloth. It is customary for the finishing plant to be allowed a certain working loss which amounts to 2 or 2½% of the total of the order. Thus, with the working loss of 2½% on an order of 100,000 yards, the plant is obligated to deliver 97,500 yards. This gives a margin of safety of 2,500 yards. During the process the cloth in some cases increases in length. This average is the property of the finishing plant. On the other hand, if it falls below the required delivery of 97,500 yards it must make good in cash the difference on the basis of the value of the grey cloth. Each variety of cloth is designated by certain styles as it comes from the cotton mill. This is determined by the width, number of picks per inch, quality of cotton yarn used, ply, and other varieties of manufacture. The average length of time for carrying a style is six months.

to about 250,000 yards. All seconds are billed at one-half price. Wherever possible, piece-rates with a bonus for attaining a certain production are paid.

In each department there are fixed bonuses for supply men and other day labor. For instance, a supply man might receive a bonus of 50 cents a day provided each operative that he supplied made a bonus. The janitors receive an allowance of 40 cents or 50 cents a day provided there are no complaints about their work. The move gang have an allowance of 50 cents a day provided each department they supply is kept going. These rates are arbitrary and not scientifically determined.

The piece-rates are set by time study. An allowance is made for each operation which is multiplied by the actual work done and the allowed time found. This allowed time is compared with the time actually used on the operation, and if it is more than the actual time, the operative is paid on the basis of the allowed time, plus a bonus of 10 to 20%.

The following are the piece-rate operations and personnel of the various departments:

1. Grey Room

A. *Laying Out Cotton.* This consists of opening the bale, laying out the ends of the pieces preparatory to sewing them together in a continuous string, and stamping the ends with the order and roll numbers.

There is a piece and roll allowance, since at the end of each roll it is necessary to add the yardage in that roll and mark it on the report.

B. *Laying Out Silk.* Laying out silk requires a separate piece-rate, since the process is slightly different. The individual pieces are not stamped, but a cloth tag is sewed to the end of each roll.

A piece and roll allowance similar to that of process A is made.

C. *Sewing All Goods.* Payment is made at a yardage rate for sewing the ends of the pieces together on a power machine.

The personnel of the grey room consists of one foreman, two inspectors, and four operatives.

2. Singe House

There are no bonus-rates in this department. The machines

run at very high speed and production is not dependent on the skill of the workman. Two operatives are all that are required to tend the machines.

3. Mercerizing Department

Piece-rates are based on the yards handled, with an allowance for shortages. A foreman, one second hand, a supply man and six operatives make up the entire personnel.

4. Bleaching and Washing Department

There are no bonus-rates in this department because the production is not dependent upon the skill of the operatives; the foreman is relied on to keep up production. The personnel consists of one second hand, two kier boilers, one sewer, and fifteen other operatives besides the foreman.

5. Dry Room

Drying consists of passing the wet cloth from the bleach house over cylinders full of live steam. Since the speed of these machines is governed mainly by drying conditions, and not by the individual workman, the piece-rate is figured on the basis of an allowance per yard for delays. The workman can increase production by starting quickly in the morning, by quickly fixing break-downs, and by eliminating unnecessary delays. The actual time spent in delays, as determined by a service recorder or productograph, is compared with the time allowed for delays and a bonus paid if the actual does not exceed the allowed. The personnel of the dry room consists of a foreman, one supply man, and eight operatives.

6. Winding Room

The cloth from the dry room is placed in long wooden boxes where the tears and rips are sewed. These boxes are then taken to the winding room where the cloth is measured and wound on wooden rolls preparatory to dyeing.

A yardage and roll allowance for winding is made, since it is necessary to take the full rolls from the machine and replace them with empty ones. A foreman and second hand supervise the work of this room. There are three operatives in the department.

7. Cotton Dyehouse

A. *Pad Dyeing.* An allowance per roll and per yard is made,

and since the machine has to be cleaned up after each color is run, an allowance is also made for each cleaning up.

B. *Jig Dyeing.* This process takes longer than pad dyeing. It is used for dark shades, such as seal, navy, cardinal, and the like. An allowance is made for each roll, yard, and clean-up in arriving at the bonus.

C. *Water Mangling.* The cloth is run through an ordinary mangle to remove excess dye liquor. A roll and yardage allowance is made.

D. *Can Drying.* A roll and yardage allowance is made. There are 10 operatives, one drug weigher, a second hand, and a foreman in this department.

8. Silk Dyehouse

A. *Stripping.* This is done to remove gum and to "wet out" the goods. A roll and yardage allowance is made in figuring bonus.

B. *Bleaching.* Both a roll and yardage allowance is made for this operation.

C. *Jig Dyeing.* Allowance is made the same as in the cotton dyehouse. The personnel is made up of nine operatives, one drug weigher, one second hand, and a foreman.

9. Printing Department

Since increased pay or bonus would tend to speed up the printers (who are highly skilled operatives) and would result in spoilage, there are no bonus-rates in this department. In the print room there are 37 operatives, 12 supply men, a colorist, one clerk, one second hand, and the foreman. In the color shop there are a foreman, a second hand, 2 clerks, and 15 operatives. The engraving shop requires 31 operatives, 2 supply men, a second hand, and a foreman.

10. Soaping Department

There are no bonuses in this department for the same reason as above. Six operatives in addition to two supply men and the foreman make up the personnel.

11. Steaming and Ageing Department

There are no bonus-rates in this department since it is en-

tirely machine processing and production is not dependent on workmen. Seven operatives are employed under the supervision of a foreman and a second hand.

12. Rope Soaping and Cleaning Department

A. In running the shrinking machine a yardage allowance is made and a bonus paid on production over a quota of yards handled.

B. *Extracting (Hydro-extractor).* Much of the time consumed in this process is in packing and unpacking the extractor. This is dependent, of course, on the skill of the operative, but an allowance is made for changes in figuring bonus. Seventeen operatives make up the direct labor personnel; one foreman and one second hand have charge of the room.

13. Cotton Tenter Room and, 14, Silk Tenter Room

All fabrics go through the same tentering processes. Since the speed varies with the character of the cloth run and not with the skill of the workmen, an allowance per yard is made for delays. The actual time stopped is determined by a service recorder or productograph and compared with the delays allowed. From this data the bonus is figured which applies to all people working on the particular machine. The personnel of the cotton tenter room consists of 35 operatives, 6 supply men, a mechanic, a cleaner, a second hand, and a foreman; that of the silk tenter room consists of 7 operatives, a supply man, a second hand, and the foreman.

15. Calender Room

A. *Calendering.* Various piece-rates are paid depending on the speed and character of the calenders. Both a roll and yardage allowance is made.

B. *Marking Selvage.* A roll and yardage allowance is made for running the cloth around a cylinder which stamps a trade name on the selvage. Six operatives, a supply man, and the foreman make up the personnel of the department.

16. Folding and Inspecting Department

Most cloth is folded in one of two ways: It is "long folded" in its full width, or it is "double folded" in the middle and rolled on a board.

The first step in the long fold process is "hooking." Rolls of cloth from the calender room are placed in a machine which hooks them off in yard lengths and bends or creases each fold. The operatives cut out all seams. Payment is made on a yardage basis for this process. The next step is folding and inspecting. The operative turns over each fold and inspects for tears and imperfections, which she cuts out and at the same time counts the yards. Since each piece must be marked at the end and recorded on the order card, a yardage and piece allowance is made. The final operation consists of wrapping with paper and tying with tape. A piece allowance only is given on this work.

Doubled and rolled goods are handled somewhat differently. The cloth passes before the operative before it is doubled for inspection. She stops the machine and cuts out all bad places. A yardage and piece allowance is made, because each piece must be taken from the machine and a new board inserted. The cut edge of the piece is then turned under, and the piece tied with tape. For this a piece allowance only is made. The folded piece finally is wrapped in paper, tied, and a label pasted on the end to show the yardage and style number. The operatives receive a piece allowance. In this department the piece-rates will often vary for different styles and varieties of cloth. Thirty operatives, five supply men, three second hands, and the foreman make up the personnel.

17. Packing Department

Fancy labels are often pasted on the pieces for which a piece allowance is made. The yardages are then listed on an adding machine for which the operators are given a piece allowance. Tickets are then tied on the pieces and another piece allowance made. A piece and case allowance is made for packing, which is the last operation. The personnel consists of seven operatives, two box nailers, three inspectors, one second hand, and the foreman.

Administration

The administrative personnel of the Greyson Finishing Company is as follows:

Manager
  Assistant to manager

Superintendent
Office Manager
Twenty-five clerks and stenographers
Master Mechanic
Seven mechanical bosses
Thirty mechanics
Two watchmen
Employment Manager
Two clerks
Cashier
Three payroll clerks
Efficiency Expert
Two engineers
Head of Scheduling Department
Eight clerks and order chasers
Chief Engineer
Five engineers and firemen
General Storekeeper
Three clerks and helpers
Three Division Superintendents

In the auxiliary departments the personnel is as follows:

Shipping and Receiving
Foreman
Six handlers
White Stock Room
Foreman
Clerk
Three operatives
Rag Room and Janitors
Foreman
Five janitors
Three rag collectors and sorters
Elevator Department
Three elevator men
Yard Department
Foreman
Four laborers
Stable men
Trucking Department
Three drivers

In making charges for finishing cloth the company has taken into consideration the following factors.

1. Amount of dye and its price
2. Fastness of color
3. Number of colors
4. Width of cloth
5. Weight of cloth
6. Speed at which cloth can be run
7. Kind of finish desired
8. Number of operations necessary
9. Construction of cloth
10. Amount of shrinkage
11. Expected waste

28. THE STAR GARNETTING COMPANY—INSTALLATION OF AN ACCOUNTING SYSTEM

The Star Garnetting [1] Company, a subsidiary of the Anderson Waste Company, had been allowed 2 cents per pound of product for processing, which was credited to a profit and loss account. This account was debited with all labor and overhead charges and the balance each six months was carried to the surplus account of the Star Garnetting Company. This system of accounting, however, had failed to show the cost of various grades of waste handled. The management was desirous of securing this information in order to utilize its plant on grades which brought in the maximum of profit.

Materials Used. The raw material received by the company was waste from cotton, woolen, underwear, and hosiery mills and also some cutting-up industries. One of the important raw materials was "card-fly" which is the waste of short fibers eliminated by the carding machines in cotton mills. Another was underwear "clip," the necessary waste from cutting out underwear and hosiery. This material was composed of cotton, mixtures of cotton and wool, of cotton and silk, or of silk and wool. Still another raw material was the waste from cutting out sweaters and wool clothing which also might be composed of cotton, or cotton and wool, or silk and cotton. The finished product, called waste or shoddy, resembled raw cotton or wool

[1] Garnetting is the cleaning and carding of textile shoddy in a Garnett machine.

which had been cleaned, although it differed from these in the length of fiber and in spinning qualities. The better classes of cotton and wool product were spun into yarn and used to make woven or knitted clothing, sweaters, hosiery, and underwear. Other qualities were made up into cheap broadcloths, cotton, or woolen fleeced materials, and felts. The cheaper qualities were used for mattresses, especially during periods when cotton prices were high.

The raw material was received on the first floor, in bales of about 500 pounds. They were stored either on the first floor or the fourth. When put into process they were transported to the second floor where they were broken open and mixed or "batched." From here the batches were trucked to the rag pickers on the same floor to be shredded. From the pickers the material in shreds was blown into rooms on the third floor from which it was taken by armfuls to the garnetting machines. After going through these machines, it was baled on the same floor and transported to the first floor for shipping.

Handling Processes. In the receiving room each bale was tagged with the number of the invoice, source number, and weight. If more than one kind of material was received from a source, the particular kind was given a number designating the kind. A record was kept in the office of each bale received by these source numbers which indicated, for instance, an Egyptian[1] "clip" from the X Company. When orders were received for a grade of waste from the Anderson Company, which sold the product, the production manager referred to this inventory of bales on hand and made out a production or "mix" order. This showed what bales went into a particular batch and that batch was afterwards referred to by bale numbers which indicated the source and kind of the ingredients.

This mixing operation was considered the most important in the process and particular mixes were kept secret. The mixing was done by hand. The bales which were indicated on the production order were assembled on the first floor and opened. The mixer took the required number of pounds to make up the batch by handfuls from alternate bales and laid them in layers on the floor. After each two or three layers an emulsion was sprinkled on the batch in order to prevent the fibers from flying

[1] Underwear clippings composed of Egyptian or long fiber yarns.

out through the air during the picking and garnetting processes. Because of the fact that wool and silk did not fly, this "wetting down" was done only when the mixes were composed largely of cotton.

The next process was picking, which was done on the second floor. Vertical sections of the batches were placed on large trucks and lifted on the elevators to the second floor where there were four hand- and four automatic pickers. The hand-pickers required one man to each machine to keep the hopper of the machine filled with material from the trucks. The automatic pickers required one man to each two machines to dump the material from the truck into large bins from which it was automatically fed into the hopper of the picker. The picker consisted of several rotating cylinders with heavy spikes on the surface which tore the raw material into shreds. The heavier masses of fiber, which were not disintegrated, were separated by centrifugal force and thrown back into the hopper. The processed material, which resembled raw cotton, was fed automatically into pipes through which it was blown to the third floor where the garnetting was done.

Garnetting Process. On this floor there were six 40-inch garnetting machines. One man fed three machines and another man was required to take off the garnetted material from the three machines and place it on trucks which went to the baling machines. The material received from the room below was kept in several bins from which the operative took it in large armfuls to the hopper of the garnetting machine. This machine consisted of large cylinders with fine hooks on the surface and revolving wire brushes which broke the shreds into fibers, removed foreign material, and placed the fibers approximately parallel. This material was taken off the machine in flat sheets which were broken up by the operative as he gathered it from the three machines and loaded it on the trucks.

The garnetted material was baled on the same floor and the bales tagged with mix numbers and lowered to the first floor shipping room. Since the product was confined to comparatively few mixes, these were readily distinguished as they went through the process. The tagging could be done, therefore, by the baler without the necessity of records to show him the composition of the bales.

Daily production reports giving the number of bales of each mix were made by telephone to the Anderson Waste Company for the purpose of securing shipping directions.

Manufacturing Costs. All laborers in the plant were paid on a day-rate. The payroll of the superintendent, clerks, and foreman was not separated from that of the ordinary laborers. Overhead charges consisted chiefly of power, light, 10% depreciation annually on the machinery, and repairs which were necessary to keep the cylinder points sharpened and other parts of machinery in condition. The payroll and overhead, which were approximately equal, were charged into a profit and loss account which was credited with the 2 cents per pound of product.

The only reports made by the Star Company to the Anderson Company were the daily production reports. An inventory of bales on hand was kept by both companies. The only directions received by the Star Company were to make a batch composed of particular amounts of specific bales which the Anderson Company knew from its records were held in the storeroom of the Star Company.

The garnetted material was sold in a highly competitive market. Prices were fixed largely without regard to costs. The exact costs of various mixes could not be estimated with this system of accounting, because there was a difference in the time required to run different mixes, a difference in the amount of waste as well as a regain in weight on account of the emulsion, and, in some cases, a difference in the processes through which the material went. Card-flys, for instance, did not go through the picking process, but directly to the garnetting machine.

What accounting system should the Star Garnetting Company have installed? How should the forms have been drawn up?

29. EDSEL MILL—FORMS

The management of the Edsel Mill wishes to have drawn up a set of forms to be used in reporting cost information. For the purposes of control, the Edsel Mill is divided into the following four departments, according to process and operation:

1. Picking and carding
2. Spinning, spooling and warping

3. Dressing, drawing-in and weaving
4. Cloth room

1. Picking and Carding

The operations in the picking and carding departments are as follows:

1. Receiving
2. Weighing
3. Classing
4. Mixing
5. Picking
6. Carding
7. Drawing

A shipment of cotton received at the mill's warehouse usually consists of approximately 100 bales. Each bale as received is tagged with serial numbers which identify it until it goes into process. On the receiving floor the bales are weighed, and the weights recorded on a cotton-received form, which should also contain the railroad line, car number, date unloaded, the date weighed, the invoice number and the weight of each individual bale. This form is required by the treasurer's office in Boston for the purpose of making allowances for differences in weights billed and weights received.

Classification. After the cotton has been placed in the storehouse, samples of about one pound are drawn from each bale in order to classify the bale according to grade, staple and color. The gradations for these respective purposes are as follows:

Grade	Staple	Color
G.O.—Good Ordinary	0	A.—White
S.G.O.—Strictly Good Ordinary	1	C.—Creamy
L.M.—Low Middling	2	S.—Spots
M.—Middling	3	L.—Light Tinges
S.M.—Strictly Middling	4	T.—Tinges
G.M.—Good Middling		H.—Heavy Tinges

It is necessary that these classifications be made both as a basis for adjustments in the price paid for the cotton, which is bought as a specified grade, and for determining the proper make-up of a mix of 100 bales put into process. The class sheet, a copy of which goes to the treasurer and another copy to the mill office, should provide for a record of each bale, the invoice number, and also the percentages of the bales in a shipment

that are equal to, above, and below the grade for which they were bought.

Bale Tagging. It is necessary that each bale be marked with the invoice number, weight, date received, and class in order that it can be traced through as far as the mixing room, where its identity is lost. The mill must also be notified when the bale is delivered from the storehouse, when it is received in the mixing room, and when it is used. It is necessary also when the hoops and sacking are removed from the bale that their weight should be recorded for each bale. It is suggested that the tag should have four parts, which when detached and sent to the mill office will provide a record of each bale from the time it is taken from the storehouse until it enters into process.

Weekly Report on Cotton Consumption. In the picking and carding office a cumulative record is kept of the invoice number and grade of cotton put into process both for warp and filling yarn. This information must be submitted to the mill office in order that a report of the cotton consumption may be made to the treasurer's office. This form should show the number of bales, the invoice number, and the grade of cotton put into process, both for filling and for warp.

Weekly Cotton Inventory Report. In the mill office a record is kept of all cotton bales on hand. It is necessary to submit a report to the treasurer's office each week of the number of bales of cotton of each grade, staple, and color. This form should also provide for the bales held for rejection because they are off grade or for special mixing in order that the color or staple may be mixed in such a way that the resulting cotton is suitable for making yarn. The information on this report should be summarized to show the number of bales which have been graded, the number of bales not yet graded, and the number of bales in transit.

Cotton Received, Consumed and Transferred. It is also necessary that the mill office send to the treasurer a report of the receipts and number of bales and weight by invoices received during the week. On this same report should go the number of bales put in process by grade and color, for warp and filling separately, with a total of each grade and color. A third part of

the form should provide for a stock report made up of the balance at the end of the week previous, bales used during the week, bales rejected, sold or transferred, bales received, bales in transit, and total bales on hand or in transit at the end of the week.

Production by Machines and Operatives. After the cotton is opened and mixed, it is passed through pickers which remove foreign matter and place the cotton fibers in a lap about one inch thick and 40 inches wide, rolled on a steel core. These laps then go to carding machines which further clean the cotton and lay the fibers in an approximately parallel position. The product of the carding machines is a rope which is then drawn out into a size of a heavy cord on the drawing and roving frames. The operatives of these roving frames are paid for the number of hanks (840 yards) of different size cords or rovings produced on the machines. It is necessary that the overseer or second hand of the picking and carding department list for each roving frame the daily production as shown by the hank-clocks on the frames. These hank-clocks give a reading up to 100 of the number of hanks produced on a frame. The daily production of the frame is usually between 5 and 10 hanks. In order that the piece pay for each operative may be ascertained, it is necessary to keep a record of the daily readings of the clocks for a week, the daily production for each of 48 frames, and the amount of pay earned by each operative during the week.

Production Report. The treasurer's office requires that the picking and carding departments make a weekly report of the production of each size of roving, and the wages paid compared with a prescribed payroll schedule. The production report should show the number of roving frames scheduled on each of 12 sizes of roving, the average number of frames stopped, and the average run during the week. It should also provide for the production of each size of roving in hanks compared with 100% standard for the average number of frame runs, and a column giving the percentage of product on the frames run compared with 100% standard.

A second part of the production report should repeat the number of frames scheduled with the production in hanks that those frames should make running full time. Space should be pro-

vided for the hanks actually produced and the percentage of hanks produced compared with what the frames scheduled should produce.

A third part of the report should record the total hanks of each size of roving and the average size actually produced on these frames. These data give a record of the variations in the size of roving produced on the drawing frames. A number .65 roving, for instance, may vary so much that for the week an average number .60 roving was produced. This average number multiplied by the theoretical production in pounds for the frames run on that number gives the theoretical pounds which should have been produced. Space should be provided for the theoretical pounds produced and the actual pounds produced with a percentage of actual to theoretical. The reverse side of this form should provide for a payroll schedule divided into general wages in the department, and the piece-wages in each of the three types of drawing machines, slubbers, intermediates, and speeders. This should show the piece-rate in dollars paid, the amount of general wages fixed by the departmental schedule, and the amount of piece-wages based on production of these three types of roving frames. Then a column should be provided for the actual amount paid for general wages and piece-rates. The difference between schedule and actual amount paid should be given in another column, and space should be provided for explanations of departures from this schedule.

Mill Office Inventory. The mill has six storehouses which it may use for cotton. Each week a physical inventory must be sent to the mill office showing the location and number of bales for each invoice.

2. Spinning, Spooling, and Warping

Daily Report on Yarn Sizes. In the spinning room it is necessary to make out a daily report of yarn sizes. This is done by taking specimens of yarn at random from different spinning frames. These specimens are measured, weighed, and their count computed.[1] Since it is impossible to spin a uniform weight of yarn, the count of these specimens will vary. On the report, therefore, space must be provided for four different

[1] The count of yarn is expressed in hanks per pound, each hank being 840 yards in length. A 28's yarn is 28 hanks to a pound.

specimens, a total, and an average which is compared with the standard count. This form should have two divisions, one each for warp and filling, and subdivisions for the five different numbers of yarn being spun in the mill.

Rewinding. In the spooling room the warp yarn which is wound on bobbins by the spinning frames is unwound and the contents of several bobbins rewound on a spool in a continuous length. The operatives of the spooling frames are paid for the number of boxes of empty bobbins which they remove from the frames.

What method should be used for keeping a record of the boxes filled by each operative?

Warping Record. In the warping room the yarn from 300 or 400 spools is wound on a single beam or steel core about 40 inches long. Each operative tends to six warpers and is paid for the number of pounds warped each week. The weights of the beams, when they are completed, are recorded on a weekly warping record sheet. This sheet should provide space for the 36 different warping machines for each day of the week.

Weekly Report on Operations. A spinning, spooling, and warping report is made out each week. This is similar in form and in the information required to the roving report in the picking and carding department. Instead of roving numbers, however, 10 yarn numbers are used and the number of frames scheduled and run, and the production of each number is recorded. In addition space must be provided for spooling production, spindles allotted to each number of yarn, the spindles run, and the pounds of production. Space is required also for the warpers allotted to each count of yarn, the number of pounds actually warped, the number of warpers run, the number of beams warped, and the number of pounds per warp. On the back of this report the payroll schedule compared with wages actually paid is shown, as on the roving report referred to above. This, however, must provide for a division into warp spinning, and filling spinning. In each division are subdivisions for the general wages and piece-rates. Piece-rates are subdivided for spinners and doffers. (The doffers remove the filled bobbins from the spindles and the spinning frames.) Space

must also be provided for the general wages and piece-rate paid for spooling and warping.

3. Dressing, Drawing In, and Weaving

Dressing Report. In the slashing room a weekly report is made of the loom beams dressed on slashers, or dressing machines. On each of these machines, four to six warp beams which were made up in the warping department are placed one behind the other, and the ends of yarn are combined in a flat sheet about 50 inches wide which is passed through a dressing mixture, dried on a large revolving copper drum, and wound on a loom beam. The report should indicate the style of cloth into which the complete loom beam is to be woven, the number of ends which it contains, the weight and length (expressed in the number of cuts which are 60 yards each), and the number of such beams dressed. In addition, space should be provided for the waste, divided into soft and hard, which is composed of yarn before and after being dressed respectively. This report should provide this information for each day of the week.

Summary of Dressing Room Operations. These reports provide information for a summary or weekly dressing room report which lists the styles of warp, the number of ends in each, and the number of beams, cuts, and pounds slashed. Another division of the form shows the number of these beams drawn-in (this operation consists of passing each end or thread of a beam through a comb and then through an eyelet of the loom harness) and the number of beams on hand in the dressing room ready for the weave room. A third division of the form provides space for the pounds of starch used, divided into potato starch and corn starch, the pounds of tallow, gum, and borax used, the gallons of oil consumed, and the pounds of hard and soft waste produced during the week.

Report on Warps Required. In the weave room a weekly report of warps running out is made. This report should provide for space for 25 different styles of warp, which may be in any one of three widths: 32 inches, 40 inches, and 42 inches, and should indicate the number of beams of each style which, it is expected, will be completed in the looms during the next week. Opposite this number there should be space for the

number of beams of that style on the floor, ready to be put into the looms. The difference between these figures should indicate the number of beams which must be prepared in the warping department the following week. This report goes weekly to the spinning, spooling, and warping room.

"Warp Beam Call." In addition to this report a daily "warp beam call" is made out in the weave room office and sent to the spinning department. This indicates the number of beams needed the next day and the number on hand of each of 12 styles.

Weave Room Operations. Another daily report made out in the weave room for the mill superintendent should provide space for each of 10 different styles of cloth produced in the mill and should indicate for each style the number of looms run, the number of looms stopped for lack of warp, the number stopped for lack of filling, the number stopped for changing beams, the number stopped for repairs, the number stopped for miscellaneous reasons, and also the number of beams of each style and the pounds of filling yarn on hand. A weekly report is made out in the weave room for the treasurer's office, a copy of which goes to the superintendent. This should show the number of looms scheduled on each of the 10 styles of cloth, the average number of looms actually run on each style, and the net product both in pounds and in yards. It should indicate the average yards per pound woven, standard yards per pound for that style, the number of yards per loom per week produced at 100% production, the actual yards produced, and the percentage of actual yardage production to standard production. Another part of this form should summarize the above figures. This should show the 100% standard yardage production for the number of looms scheduled running full time, the actual time run, and 100% production for the actual number of looms run. Then a comparison expressed in a percentage should be made of the actual production in yards to the full time production, another to the actual time run production, and another to the looms run production. Still another part of this report should show the average looms stopped per day because of given stoppage reasons, namely: a lack of weavers, lack of warp, lack of filling, changes and repairs. On the back of this

report a space should be provided for the style numbers of cloth, and the number of cuts (60 yards) produced during the week with the piece-rate for each style and the total amount paid in piece-rates, and it should also provide for the general wage schedule, the actual wages paid, the difference and explanations of the differences.

Most of the information going on these weave reports is kept in the weave room in the following manner: First, a wide sheet with 60 lines is prepared. The left-hand column provides for the various style numbers. In the next column, opposite the proper style number, the number of looms proposed is placed. (Loom proposals or statements scheduling a specified number of looms on a style of cloth are received weekly from the mill office.) Then columns are provided for the different widths of looms used in the mill. In these columns are entered the figures of the number of looms proposed for each style. A typical entry on this sheet would show, first, the style number, say 307, 6 looms proposed, and under the 40-inch loom column the number 6 again. A space is left to the right of these columns for notes.

Each day the number of looms run on each style of cloth is recorded, also the number stopped for filling, for weavers, for changes, for repairs, and for warp, the number of warpers wanted, warps drawn, the number of warps not drawn and the number of cuts woven. In order that the condition of each style may be ascertained quickly, each daily report sheet is narrower than the preceding day's sheet by the width of the column which provides for the number of looms run. In this column the number for each style is placed opposite to the style number on the proposal sheet first described. At the end of the week the total of looms run is figured, the average looms run recorded, and the total looms stopped for each of the reasons is entered. Since each successive sheet is narrower than the preceding one, the whole series when they are bound together present the appearance of a single report. The left-hand column of the report shows the styles of cloth; the next column shows the looms proposed; and the next six columns show the number of looms run on each style of cloth; finally there are the total columns, looms run, the average run, and the total stop for the five reasons, the total warps drawn, the total warpers not drawn,

and the total number of cuts woven. By turning each daily sheet, the information for each day can be ascertained if desired.

Cloth Room. In the cloth room the cloth is inspected, cut into 60-yard pieces, and baled. Before being baled, however, the pieces (usually from 25 to 30) are weighed. The weight of each piece and its yardage are recorded separately on a bale card, serially numbered, which is attached to the bale until it is shipped, thus providing a record of shipments. It should contain, besides the weight and yardage of the bale, the style of the cloth, the date weighed, the production order number, the shipping order number, date of shipment, and space for stamping and packing instructions. At the bottom the total number of pounds should be entered with the average yards per pound in a bale.

Baled Cloth Record. A daily record of yards per pound in each bale of each style of cloth is kept along with the standard. This should show also the packing limits in yards per pound. This is used to check whether the cloth is running at standard number of yards per pound and to indicate any allowance to be made to customers for cloth which is beyond the permitted limits of yards per pound.

Cloth Invoiced Record. Since all cloth is invoiced to the selling house as soon as baled, a daily report of all cloth invoiced is made to the treasurer's office and to the mill office. This report should list the style numbers and all the bale numbers of each style which has been weighed, the number of pieces in each, the total weight of all bales, the average weight expressed in yards per pound, and the total yards. Space should be left for the entry of the destination of each bale, the order number, and the account number.

30. THE HARRINGTON WOOL COMPANY— ACCOUNTING FOR BY-PRODUCTS

The Harrington Wool Company was a firm of Boston wool merchants which bought raw wool, sorted it, had it combed by an independent mill, and then sold it. It used three principal cost records, from which its book costs were obtained and its selling prices estimated.

The first record was an estimating sheet, similar to the following form:

Grade	Sort Inventory	Sort Market	Cost of Conversion	Cost in Top	Offering
36's Z	$0.40	$0.45	$0.11	$0.56	$0.65
40's K	.45	.50	.11	.61	.68
44's C	.50	.52	.12	.64	.70
46's W	.55	.60	.13	.73	.80
50's L	.70	.73	.14	.87	.97
54's S	.80	.83	.16	.99	1.10
56/58's H	.90	.93	.18	1.11	1.20
60's T	1.10	1.15	.25	1.40	1.45
64's R	1.25	1.30	.32	1.62	

The grades shown in the first column were standard for the wool trade as a whole. They were followed by a series of letters, used by the Harrington Wool Company to indicate its private grade names. Column 2 contained conservative figures used for inventory purposes, which were in every case less than the company's best estimates as to what each sort of wool in the grease was bringing in the market given in column 3. Column 4 showed the estimated cost of conversion into tops, whereas in column 5 was given the estimated cost of the finished product in tops. The last column showed the approximate price at which salesmen were to make offerings. Sheets of this sort were compiled and distributed as often as there was any considerable change in the market. All costs on this sheet were for one pound of wool.

The second form used, the sorting record shown on page 508, indicated the number of pounds received in a lot, the results of sorting, and the prices paid for each grade in 100-pound lots.

A lot of 2,884 pounds, contained in 13 bales, had been bought. An allowance for tare, in this case 3 pounds per bale was made, reducing the wool to be accounted for to 2,845 pounds. At the time of sorting there were 456 pounds of grade S, 1,632 pounds of grade L, 415 pounds of grade W, 74 pounds of grade C, and 32 pounds of grade Z wool, besides 67 pounds of stained and grey wool, 102 pounds in wool clips, and 12 pounds of string. The total weight, therefore, was 2,790 pounds; there was an unaccountable shrinkage in sorting of 55 pounds, which might

SORTING RECORD

	1	2	3	4	5
Grade	Lbs.	Per Cent	Prices in Grease	Prices Clean Wool	
S	456	17.5	$0.36	$0.78	$ 6.30
L	1,632	62.6	0.46	1.00	29.07
W	415	15.9	0.255	0.55	4.05
C	74	02.8	0.215	0.47	0.60
Z	32	01.2	0.16	0.35	0.19
	2,609	100.0			$40.21
Stained and Grey	67		Average on hand		$36.25
Clips	102		Shrinkage factor	.08	$39.15
Strings	12		Sorting		1.06
	2,790				$40.21
Loss	55				
	2,845				

have been a loss in moisture content. In the second column were shown the percentages of wool sortings in each class; no attention was paid in this calculation to any waste, which although it did have a small value on the market, was treated as worthless. From the books the average price of wool on hand which was bought primarily for L wool was ascertained. To this figure ($36 per 100 pounds) was added 25 cents for handling charges. Since the stained and grey, clips, strings, and loss in sorting amounted to 236 pounds, the shrinkage factor, a little more than 8%, was found by dividing 236 by 2,845, the total number of pounds after subtracting the original allowance for tare. By applying this percentage to $36.25, $2.90 was obtained, which added to $36.25 gave $39.15 as a result. The estimated cost of $1.06 for sorting was added, and the total was $40.21. Since 62.6% of this lot was of L grade, L grade was considered the main product and the S, W, C, and Z grades by-products. Estimates were made as to what the S, W, C, and Z grades were worth free from grease in the market; then the percentage of shrinkage in cleaning was reckoned, in this case 54%. The figures in column 4, those for clean wool, were converted into estimated costs for wool in the grease. For example, if 100 pounds of clean S wool were worth $78, and wool in the grease contained 46% of clean wool, there were 46 pounds of clean wool in each 100 pounds of wool in the grease, each of

which was worth 78 cents. By multiplying .78 by 46 it was found that one pound of wool in the grease was worth $.3588, or roughly, 36 cents. The price per pound of each sort of wool in the grease was multiplied by its respective figure in the second column, which showed the number of pounds per 100 there were of the particular sort in this lot of wool. The results of this series of multiplications were listed in column 5, the space for the L grade being still left vacant. The total of this column had to be $40.21 to agree with the average cost as ascertained previously. The figure for the L grade, $29.07 was found by subtraction. Since there were 62.6 pounds of the L grade in each 100 pounds, and since they were worth $29.07, the cost per pound was 46 cents, and the cost per pound clean was $1.00.

The third record in use was the following sorting report from the mill which prepared the tops for the company:

SORTING REPORT FROM MILL

			Sent	38,546 lbs.	
			Actual Tare	672 lbs.	
			Net	37,874 lbs.	
168 Bales Matching	L Grade	37,874			
	L Card Waste	98	Quality L Grade		
	L Comb Waste	9			Per Cent
	L Wool Waste	46	75 Bales Tops and Sample		
		38,027		17,783 lbs.	46.76
Greasy Cost	$39.43		32 Bags Noils and Sample		
Yield	56.89%			3,160 lbs.	8.30
Clean Cost	$69.31		Dusted Card Waste	54 lbs.	.14
Top	84.9 lbs.	$59.95	Clean Burr Waste	639 lbs.	1.67
Noil	15.1 lbs. @ 62¢	9.36	Comb Bits	9 lbs.	.02
		$69.31	Shrinkage		43.11
					100.00
Cost of Wool	$0.706				
Comb Cost	.12				
Total of Tops	$0.826 per pound				

This form showed the quantity of one grade sent, the actual tare, and the net weight. The net weight was added to 98 pounds card waste, 9 pounds comb waste, and 46 pounds wool waste, on hand at the mill from previous lots. From this amount the mill had produced 75 bales of tops and sample amounting to 17,783 pounds, or 46.76% of the whole; 32 bags, or 3,160 pounds of noils and sample, or 8.3%; 54 pounds, .14% of dusted card waste; 639 pounds, or 1.67% of clean burr

waste; 9 pounds, or .02% of comb bits; and a shrinkage of 43.11% had taken place, so that the yield had amounted to 56.89%. The greasy cost of the wool was $39.43 per 100 pounds, and the clean cost was $69.31, which was obtained by dividing $39.43 by 56.89% and multiplying by 100. The mill had produced 3,160 pounds of noils and 17,783 of tops. The total of these two groups was 20,943, of which noils were 15.1% and tops 84.9%. At the estimated cost of 62 cents, 15.1 pounds of noils were worth $9.36, and since 100 pounds of noils and tops in the given proportions were worth $69.31, the value of 84.9 pounds of tops was $59.95, from which the pound cost for tops was found to be 70.6 cents. To this was added the mill's charge for combing, 12 cents per pound, giving a total cost per pound for tops of this grade as 82.6 cents.

In the Fisher Wool Company when a lot was purchased and sorted, the number of pounds of each class of wool in the lot was multiplied by the market price for that class, and a total market value for the entire lot was ascertained. This market value was compared with the purchase price of the lot, and the difference carried to the profit and loss account as a loss or gain.

The Holland Wool Company used a cost method substantially similar to that of the Fisher Company, but it carried the computation a step further to avoid what it believed was an anticipation of profit. When the market price for each class in a lot had been figured, as well as the market price for the total lot, the market values of each class were reduced or increased proportionately in order that the total would agree with the price paid for the lot. These adjusted figures were used as the cost figures for each class of wool.

Should the Harrington Wool Company have substituted the cost method of the Fisher Company or the Holland Company for the method it was employing?

F. RUBBER AND LEATHER

31. ROVER RUBBER COMPANY—ACCOUNTING SYSTEM

THE Rover Rubber Company manufactures fabric tires, cord tires, solid truck tires, and inner tubes; it also makes "air-bags," which are used in molding the tires.

In the manufacture of its products the factory uses crude rubber, sulphur, compounds, and cotton fabrics. Fabrics are used in both fabric and cord tires; steel bands are used in the manufacture of solid truck tires, and steel wire in the beads of some of the heavier fabric and cord tires.

The Compounding Department. After the raw gum is washed and dried, it goes to the compounding department, where it is made up in lots, or batches, which are carefully weighed, and the proper proportion of the compounding materials is added. These proportions vary for the different kinds of rubber product being made, but all mixtures are made up in this one room. The compounding process consists of putting all the materials through a machine, which mixes them uniformly. The mixture is then allowed to stand for two days before being used.

The Gum Calender Department. Strips of rubber in various sizes for use in the manufacture of tires and inner tubes are produced in the gum calender department. The gum received from the compounding department must be broken down by being crushed between two rollers. It is then warmed and softened before it is put through the gum calender which rolls the rubber gum into strips of the desired width and thickness. The thickness is frequently tested and pieces that vary from standard measurements are put through this process again. The rubber comes from this machine in long strips which are rolled up in liners of cotton fabrics to keep the rubber from sticking, and taken to the cutting room, where they are cut by hand into the necessary lengths.

The Friction Calender Department. In this department the rubber gum is attached to fabrics by a friction process, preparatory to the manufacture of fabric and cord tires. The fabric must be carefully inspected, passed through a drying machine, and then placed in a hot room to keep it absolutely dry. Before being frictioned on to this fabric, the rubber must be reduced to a soft and plastic condition by being worked in a mill.

The fabric is passed through the friction calender three or four times. It is usually frictioned on each side and then coated on each. In the frictioning process, gum is forced into the interstices in the fabric, while in the coating process a light coat of gum is pressed on to the surface of the fabric. The resulting product must come up to predetermined standards of weight and thickness, and tests are made after each operation to insure satisfaction in the final result. The fabric also is carefully weighed before going through the friction calender and after the whole series of rollings is completed.

This rubberized fabric is cut by a machine into bias strips of sizes suitable for use in making cord and fabric tires. The amount of waste involved in this bias cutting is not serious. The strips are stored

to protect them from damage while waiting operations in the assembling department.

The Tread Tubing Department. This department prepares tread stock for the tires. As before, the rubber must be worked up into condition by cracking, milling, and warming. It is next run through a tubing machine which consists of a heavy metal barrel with a screw or worm inside it. Strips of gum are fed into this machine through an opening in the barrel and the worm forces the gum through a die which forms a strip of the proper shape to fit the size of tire for which it is being prepared. Here again, frequent tests are necessary in order to insure correct size for the later assembling. The strip coming from this machine is cut into lengths which are later applied to the tire.

Bead Department. Two kinds of beads are made from the bead stock turned out by the friction calender. One kind, for the larger tires, is made over a band of wire; the other for the smaller sizes, consists solely of the frictioned fabric. In both cases the manufacturing process assembles the strips and molds the resulting product in a bead molding press where pressure is applied to give it the proper size and shape, and in which it is semivulcanized. The bead is then trimmed, buffed, and dipped into cement; when dry, it is stored ready for use in the making department.

A complete tire is made up of the following parts:

1. *The Carcass Material.* This is the fabric which forms the inside of the tire. It has been rubberized on the friction calender and cut on the bias cutting machine

2. *The Beads.* The beads hold the tire on the wheel. There are two types: the *clincher* type, where the thick edge or flange on each side of the tire is made of rubberized fabric and fits under the rim of the wheel, and the *straight side* type, where steel wire is molded inside the bead and the tire is held on the wheel by a rim which only presses against it.

3. *The Side Walls.* The side walls, which are made of pure rubber gum rolled on the gum calender, are cut by hand into proper lengths and put on the outside of the tire adjoining the bead. They protect the sides of the carcass from the weather and any chafing by curb stones.

4. *The Cushion.* The cushion, which is made of pure rubber gum rolled on the gum calender, is the layer next to the carcass under the tread or thick part of the tire. It is used to protect the carcass from road shocks caused by loose stones and bad roads.

5. *The Breaker Strip.* The breaker strip, which is a strip of open weave fabric, filled with rubber on the friction calender, is placed over the gum top cover, under the tread. It distributes the strain of traction over a larger area and also protects the carcass from shocks.

6. *The Tread.* The tread is the outside thick strip of rubber which gets the wear on the road.

7. *The Chafing Strip.* This is made of fabric covered with rubber on the friction calender and is wrapped around the bead. It gives the tire a finished appearance and prevents moisture from working up into the carcass.

Assembling. In general, the building process consists of stretching the carcass material over a core, one layer after the other, inserting the bead, and putting on the chafing strip. The gum top cover, the side walls, the breaker strip, and the tread follow. In some cases, tires are semivulcanized at the point where the gum top cover and side walls have been put upon the carcass, but this is unusual.

After being fully assembled, the tires are placed in a mold for vulcanizing. Most tires are vulcanized on air bags which are blown up hard to force the tire into the shape of the mold during the vulcanizing process. Some fabric tires are vulcanized on metal cores without the use of air bags. An air bag can, in general, be used about 30 times before it has to be scrapped.

The Air Bag Department. The air bags are made principally of gum. They are built by covering a curved tube with several layers of cover stock and applying some hard curing stock on the inner circumference which will help in forming the bead of the tire.

The Solid Truck Tire Department. The operations in this department are similar to those in the tread tubing department. Two kinds of rubber are used; a hard curing rubber is cemented to the steel bands which serve as the base, and then covered with the necessary quantity and thickness of tread rubber, shaped by the tubing machine.

Inner Tubes. Strips of rubber gum from the gum calender are rolled upon straight cylindrical mandrels, vulcanized, cut into proper lengths, and the ends cemented together to form the finished article. In the case of large inner tubes, however, better results are obtained by making them on a circular mandrel with one strip on the outside and another strip on the inside, vulcanized together where they meet.

Construct a process chart which would show graphically the operations of the Rover Rubber Company.

What general ledger and factory ledger accounts would provide a proper system for this company?

What items should go into each of the factory accounts enumerated above?

How could the material costs be ascertained and recorded? What forms would be used?

32. EVERETT RUBBER COMPANY—ACCOUNTING SYSTEM

The Everett Rubber Company, manufacturing rubber and canvas footwear, determines the direct costs of the various products by test, and estimates the overhead from past performance. One plant, operated as a single unit, maintains the following departments, each being essentially one of the processes of manufacture.

Raw Materials. Upon receipt of the raw rubber at the factory it is weighed and delivered to the warehouse, each package being opened and examined carefully in order to be sure that it is up to standard. After inspection the rubber is stored in the warehouse under lot numbers which remain with the shipments until they are delivered to process. A large amount of the rubber is bought on sample, and many adjustments are made for quality and shortage of weight, and a lot history is kept of each shipment showing its cost. The value of the rubber is figured on the net weight after it has been dried and washed and not at the purchase weight when the goods were delivered. Each lot number is tested and recorded at the laboratory.

A daily report is made of the number of pounds of graded rubber on hand in the mill, the number of pounds in the mill not graded, the number of pounds in transit, the number of pounds on contract, and the length of time the supply will last on average consumption.

All raw materials are handled in a similar manner. The following table gives the relative value of various raw materials consumed during an average month in the plant:

Rubber	$ 450,000
Reclaimed Shoddy	35,000
Compounds	75,000
Dry Goods	550,000
Shooks and Carton Boards	50,000
Findings	60,000
Others	100,000
Total	$1,320,000

Milling Department. In the milling department all the processing of rubber takes place from the time it is received from the raw material department until it is delivered to the different calenders. This work includes the washing and drying of the crude rubber for the mixing room, the handling and weighing of the compounding ingredients to be added, and, finally, the assembling of the rubber and the compounding ingredients in the mixing room and their blending into the gum compounds from which the shoes are made.

Wash Room. Raw rubber first goes through crackers, which are two large rollers side by side in a heavy cast-iron frame, geared so that

one roller moves slightly faster than the other, thus giving a slight grinding action upon any material that passes between them. The rolls are short with deep corrugations, and are powerful enough to seize a ball of rubber and drag it between them, shredding and tearing it. Sometimes, especially in cold weather, the rubber is soaked in water before putting through the cracker in order to soften it.

From the cracker the rubber is taken to the washers, which consist of two rollers set into steel tanks, over which a stream of water is constantly played. One roller, revolving faster than the other, tears and exposes every part of the rubber to the cleansing action of the water.

Drying Room. The present method of drying consists of putting the rubber sheets in trays in a large chamber with hollow shelves through which steam is passed, the moist air being exhausted from the drier by fans. The rubber is fully dry within eight hours, at which time it is weighed and taken to the mixing room where it meets the reclaimed rubber.

Reclaiming Room. Tires to be reclaimed are sorted, inspected to check contract price, and then dissected. Various grades of scrap are obtained, each of which is treated separately. In the course of manufacturing into shoddy, the scrap is broken up in crackers, ground fine in grinding mills, screened to uniform size, and carefully washed. It then is placed in devulcanizers, containing a strong chemical solution, where it is subjected to a high temperature for a long period of time. The chemical destroys the fiber, while the heat renders the rubber more or less plastic. Upon being removed from this devulcanizer, the chemicals, as well as the solution of decomposed fiber, are washed out and the remainder is passed through screw presses to squeeze out the excess water. The residue is placed on a drying platform through which warm air is passed by putting it through the rolling mills to make it coherent, the foreign matter being removed by forcing the shoddy through a wire screen of fine mesh by means of a tube machine.

The reclaiming of boots and shoes is done by the acid process, the cotton fabric being destroyed by sulphuric acid instead of an alkali. From the screen the scrap goes to refiners where it is sheeted and rolled. It is then ready for use in the compounds and is sent to the mixing room.

Mixing Room. When the department is ready to mix, the mineral ingredients are weighed, and the rubber batch and its compounds are sent to the mixers. Compounds include inert ingredients, such as whiting and barytes, pigments such as lamp black, iron oxide, zinc oxide, and sulphur.

Rubber and shoddy are blended by being passed through two rolls set in a frame. This blending or mastication is carried on until the blend becomes more or less soft and plastic. The compounding ingredients are dumped upon the tops of the rolls and worked by them into the rubber, while the mixer cuts and folds the sheet of rubber which

is traveling around the rolls to enable it to take up the compounds more quickly. All percentages of materials in the compounds are in terms of weight.

The mixed batches are sent to the calendering department, where they are stored in bins until wanted.

Calendering. When stock is to be run, it is put through a milling machine, of the same type as was used in mixing, in order to refine and warm it before placing it on the calender machines, which run the stock out on belt conveyors to the cutting room.

Payment for this department is on a day-rate basis, plus a bonus which is calculated from the machines' running records as noted by productographs located in the calender room office. These calculations show the time when the machines are producing good stock, the time consumed in changing rolls, and in warming stock, and in any other operation connected with the running of the machines.

The stocks are tested by gages while the calenders are running to see that they conform to the standard requirements.

The calender machines do three things:

1. *Plain Calendering.* The laying of the stock on the fabric in form available for uppers, soles, and cover work is done by the use of plain and engraved rolls inserted in the calendering machines.

2. *Frictioning.* Frictioning fabric stock with gum either on one side or both sides for use in vamps, quarters, vamp linings, leg forms, joining strips, soles, and stays.

3. *Coating.* Coating the fabric with gum for use in linings.

Cutting Room. The material obtained from the calendering department by the cutting department is handled in three ways:

1. All plain fabrics, frictioned fabrics, and cut fabrics are stamped out by the use of dyes on the Parson cutting machine. The pieces stamped out are put between canvas leaves, marked with the maker's number, and sent to the making department.

2. The heavy gum outsole stock is cut by hand or machine. The hand cutters handle about 300 pairs a day, and the machine cutters an average of 900 pairs a day. These stocks are put into canvas books as they are cut, marked with the maker's number, and sent to the making room or stockroom.

3. The thin, plain rubber sheeting is handled in two ways: that to be used for covering work is cut out by laying the frictioned pieces to be covered directly on the rubber sheet and cutting around it by hand; and that for other uses is cut out by means of stamp dyes.

The payment for this department is made on a piece-rate basis, and the cutting of the fabric scrap is taken into consideration in the payment of wages, as the scrap of the fabric means a direct loss. In the cutting of the gum stock, however, the scrap is not considered in the piece-rate, as there is but a slight loss in reclaiming it.

Stitching Room. The work of this department is limited almost entirely to the production of uppers and parts for tennis and canvas shoes. Practically all the employees are girls who are paid on a piece-rate basis. The principal operations are stamping, top stitching, eyeleting, hooking, vamping, lacing, buttonholing, and assembling the different parts preparatory to the final making.

Making Room—Gum and Tennis. The making room is divided into the gum shoe making department and the tennis making department. As a feeder for the making room there is a preparatory department for preparing the work for the makers; and the transportation department which handles the sticks and bars, and moves the finished shoes. In the former department there is an insole section, a receiving section, and a sole making section which prepares the soles after they have been cut. The stock received in the preparatory department comes from the stockroom and the cutting room.

The gum shoes are made by team-work, and the processes are divided as follows:

A. *Lasting.* (1) The first operation consists of drawing a lining over the aluminum last and joining it to the insole; this forms the foundation of the shoe.

(2) In the next operation the frictioned heel piece, the frictional toe tip, and rag counter are added. The former are ruled into place with a hand rule.

(3) The final lining operation consists of placing a filler on the bottom and rolling it down.

B. *Uppers.* The gum upper is next laid on the shoe and drawn over on the bottom. All surplus stock is cut off and the rubber heel piece and a strip of foxing on the top edge of the rubber are added.

C. *Foxing.* Foxing consists of rolling down the joined places with a hand stitching roller and the putting of a strip of foxing around the lower edge of the rubber.

D. *Outsoling.* On light shoes the outsoles are laid and cemented by hand, on heavy shoes they are put on by machine under heavy pressure.

The tennis shoe making is practically the same as the gum shoe making, there being a laster, an upperer, a cementer, and an outsoler. The laster puts the tennis top over the last and lasts it to the insole. The cementer, who works both sides of the table, puts two or three coats of cement on the bottom of the shoe and on the side about half an inch above the bottom of the sole. The upperer puts on the foxing, rolls it, and passes the shoe to the outsoler who puts on the outside.

Varnishing. After the process of making has been completed, the racks of lasted shoes are trucked to the varnishing department, where they are dipped in varnish and allowed to stand for a short time.

Vulcanizing. Vulcanization [1] is accomplished by mixing rubber with sulphur and heating the mixture. Under such conditions it becomes elastic, the elasticity being retained through the ordinary range of temperature. It is not necessary, however, to heat the thin sheets of rubber to cure them, as the cold or acid cure may be used. This is done by painting the rubber with a solution of sulphur chloride and some rubber solvent, such as benzole. This cure is used only for such work as patching.

Stripping. After the shoes have been vulcanized, they are run on trucks to the stripping department, where they are removed from the lasts. The excess lining is cut from the top of the last and removed by hand.

Packing. The finished shoes are sent to the packing room for final inspection. In packing rubber shoes a triple check is used, one copy of which is nailed on the inside of the box, the other two are nailed on the outside. When the completed case is sent from the packing to the shipping department, one of the outside checks is torn off and sent to the factory accounting department where the quantities are recorded, the goods priced, and the value of factory production figured.

Shipping. When the goods are ready for actual shipment, a record is made on the daily shipping blotter with the customer's name and the number of cases being shipped. The duplicate check still remaining on the outside is torn from each case and sent to the billing department.

33. THE NEW ENGLAND TANNING COMPANY—PROCESS COST SYSTEM

The New England Tanning Company operated a plant for the production of upper and sole leather by the chrome process. Until 1918 no system of keeping detailed costs had been used. From 1918 to 1920 a method of keeping costs on individual lots of leather had been in effect. At the end of 1920 the company

[1] The reason for heating the rubber is to produce vulcanization in a reasonable length of time, as the mixture of sulphur and rubber would vulcanize at the ordinary temperature if allowed long enough. The common temperature used for vulcanizing is 280° F. There are four kinds of heat in general use in rubber factories: open heat, gas pressure heat, open steam heat, and press heat. In the open heat goods are heated in the open air at atmospheric pressure. This is used for curing light goods, raincoat fabric and lightweight footwear. It starts at room temperature and is gradually brought up to 260° F., the time required being approximately seven hours.

Gas pressure heat is generally used for curing heavy footwear, and the advantage of this heat is that it produces solid soles and tends to prevent blisters. A pressure of about 15 pounds is used.

In the open steam heat, steam under pressure is turned directly on the goods. This heat has all the advantages of the gas pressure heat and requires less time.

believed that it was obtaining little value from its costs and authorized a firm of accountants to install a plan which could be guaranteed to yield accurate results.

The company purchased green salted hides and dried hides.[1] All dried hides received were soaked to put them into the same condition as the green salted hides.

When the hides were received at the tannery, they were sorted, weighed and tared. Three per cent was allowed for shrinkage if the hides had been on the road for 3 weeks and 1% more for every additional 10 days. Two men beat 12 sample hides per car to remove excess salt and dirt and thus to determine the average shrinkage. The hides then were piled and given lot numbers.

In the raw stock house, all hides were trimmed to remove the tails, shanks, and pates, and were split down the middle of the back. Thereafter, they were known as "sides" and each side was stamped with a lot number in the form of a perforation.

When the hides were removed from the raw stock house to be put into process they were transferred first to the beam house and then to the tannery. The more important processes are described below:

Beam House

Soaking. Upon coming from the hide house, the hides are dumped into water pits to soak, where they remain for 24 hours to remove all traces of salt and as much dirt as possible.

Dried hides are soaked in an acid solution for four days, before being split and trimmed. They then are softened by being placed in a hollow drum fitted with shelves like those of a paddle wheel. As the drums rotate, the hides are given a thorough beating.

The cure of white and colored goods can be accomplished by this heat without any change in color.

Press heat is used when rubber is to be formed in molds to a definite shape for curing while in that shape. Some articles, such as heels and soles, are cured in press. The molds filled with rubber are placed between the plates which are subjected to hydraulic pressure. This closes the molds and forms the articles to be cured. Since curing is a function of time and temperature, both must be carefully watched.

Gas pressure heat and open steam heat are not used by the Everett Rubber Company.

[1] When the hide is removed from the animal it is washed clean of dirt and blood to preserve it against decay. In some places such as India and parts of South America the hides merely are dried in a cool place and then shipped. A better method is that of curing the skins in salt and shipping them wet salted to a tannery. The latter process is used by the American packers. The hides and skins treated in this manner are called "green salted."

Liming. After being removed from the water pits, the hides (both green salted and dried) are toggled (tied end to end) and placed in another pit containing sulphide of sodium, commonly called limes. The object of this treatment is to loosen the roots of the hair so that it may be removed easily, but since lime itself does not destroy the hair bulbs rapidly, some other depilatory agent is added. The length of the process varies; the hides usually remain in the first pit for 24 hours. By means of an electric reel placed over the pit, the hides are transferred to another pit containing the same solution where they remain another 24 hours to complete the process.

The hides then are reeled in succession from the second pit into the next four pits which contain straight lime. They remain in each pit 24 hours. The action of the lime dissolves what flesh remains on the skins and loosens the fibers of the hair.

After being removed from the last pit, the hides are washed in large revolving drums containing soft water. Since during this period the hides receive the treatment that later determines their quality, this process is one of the most important. The composition of the water, moreover, determines the later process to which the hides are to be subjected.

Unhairing. The operation of unhairing was originally the first of a series of manual tasks performed on a concave wooden surface called a "beam." The "beam" is still used and gives the name of beam house to the building in which these operations are now carried on by machinery. The unhairing instrument formerly used was a blunt knife with a concave edge with which the hides were scraped downward over the beam.

Checking. The flesh adhering to the inner side of the skin is removed by a machine similar to the unhairing machine, the only difference being that the helical knives are exceedingly sharp instead of being blunt. Both the unhairing and defleshing machinery work on the general principle of an ordinary lawn mower. The flesh removed by this process is called "fleshings" and is used in glue stock. The hides are put into a drench pit where they are soaked overnight.

Splitting. When the hides are taken from the drench pit, they are sorted by lot numbers into bins in the splitting room. Next they are counted and weighed, the lot numbers, number of hides, and the weight being recorded. After being trimmed, they are piled and sorted to determine to which process they should be subjected and to what use the hides should be put. The trimmings, like the fleshings, are used in glue stock.

The splitting machine, which consists of a circular knife operating at high speed between two rollers, splits the hides in two, the top part being called the "grain" and the lower part the "split." The grain usually is tanned and chromed. If of good size, the split is barked, otherwise it is tanned and chromed. The grains and splits are trimmed,

and both are weighed to determine the net weight obtained from the original hides. These trimmings are credited against the original weight of the hides, whereas none of the previous trimmings are so credited.

At this point it is necessary to work out the remaining lime from the hides to render them soft and supple. Accordingly they are subjected to bacterial action by being placed in a solution of prepared bait. Because of the comparatively rapid action of this process, great care must be exercised to prevent too great a dissolution of the hides. They usually are left in the tank from one-half to three-quarters of an hour. After being removed from the bait, they are placed in a revolving drum containing a combination of salt and sulphuric acid which prevents the chrome solution from taking hold too rapidly.

Tanning. Chrome tanning is effected by placing skins in covered vats and exposing them to the effects of chrome acid. The skins are soaked in liquor containing basic chromium sulphate or chlorid, obtained by a mixture of chrome alum and common soda, or bichlorid of potash. Taken from this bath the hides are washed, allowed to stand a day or two, and sent to the cellar where they are put through a "setting out" machine which smoothes the lengths and extracts the surplus moisture. The hides then are "shaved" to make the skins of uniform thickness.

Fat Liquoring. The next process, which generally is referred to as "fat liquoring," consists of coloring, filling, and oiling. The dyeing is done in drums of fat liquor containing an emulsion of oils which penetrates the skins and strengthens the fiber of the leather, making it soft and pliable, and at the same time giving it the desired color.

The skins then are hung out to dry, after which they are set out to remove the superfluous matter. An operation known as shanking smooths the wrinkles out in the shanks. The leather is allowed to dry until it reaches a "sammed" condition, after which it is placed in damp sawdust until soft enough to be "staked."

Staking. Staking, which is similar to setting out, smooths the surface, removes foreign matter, and makes the leather supple. Inasmuch as upper leather is sold by measurement, not by weight, this operation is of considerable importance. When the skins are dried, they are removed from the board, and the heavier skins are given a second staking. The rough edges are trimmed off by hand, and the grain usually is brushed. Each skin next is tacked on a wooden screen in such a way as to stretch it in all directions so that some of the shrinkage caused by the chrome process is regained. Hot air then is forced through the screens.

Seasoning. The hides in this factory are seasoned both by hand and machine; the mixture of wax, shellac, and paint varies a great deal with the ultimate finish to be produced. In machine-seasoning the leather is fed by a belt conveyor between several rolls which act sim-

ilarly to those on a printing press and which impregnate the surface with the mixture. The leather thus is given color, finish, and smoothness. As soon as the last coat is dried, the leather is ready for its final treatment, and the skins are sorted according to the finishing processes which are to be given them.

Finishing. Calfskin is finished in three general ways: (1) smooth-grain finish, glace, or gun metal; (2) dried-grain finish, box and willow; and (3) flesh finish, ooze, and suede. Glazing consists of giving the leather a permanent polish by rubbing it at high pressure with a glass sleeker. Where a duller surface is desired, glazing is supplanted by plating, which consists of pressing the leather in a machine similar to an ordinary pressing machine, giving a finish which is smooth but not shiny and is called gun metal. "Boarding" is usually done by hand with a tool which fits on the workmen's forearm. When finished black, such leather is known as box leather. The flesh side of calfskin lends itself readily to being raised in a short nap by severe brushing which produces a soft, velvety surface. Such finishes are known as suede or ooze.

If a piece of leather reaches the finishing stages with an imperfect grain, it often is submitted to an operation called snuffing. This smooths down the grain on a wheel equipped with carborundum cloth or similar abrasive by means of which a satisfactory surface can be obtained. This snuffed leather is of secondary grade and is sold as corrected grain calfskin.

Side leather which is to produce patent leather is subjected to the japanning process. This treatment varies considerably from all other finishes, as the sides are de-greased in a benzine solution after being fat-liquored. The sides, which have been colored a dark purple, are stretched on wooden frames and left until the entire japanning treatment has been completed. The process itself consists of applying three coats of japanning lacquer, and after each application the frames are placed on racks and baked. In the United States all three coats are applied on the grain. After the last coat, which is given to add lustre, the frames are placed in the sun and, after drying, the sides are cut off the frames, trimmed, measured, and shipped.

The following statements were included in the report submitted by the accountants after their survey:

The elements entering into the cost of finished leather are hide values and manufacturing costs, consisting of labor, material, and overhead charges, or burden. When the product is manufactured so that the cost of individual jobs can be kept separately, it is customary to accumulate raw material and each element of manufacturing cost job by job or lot by lot. This ideal plan obviously cannot be applied on any product that is manufactured like upper leather by a series of continuous processes, i. e., where the units flow along from one operation to another without lots being kept distinct.

Under such conditions the simplest and most accurate way to get accurate costs is by what is called process rates. This method consists of dividing the entire plant into departments or production centers and then allocating to each center its share of all the operating costs. The total of these costs in any one center is applied to the product passing through the center on any basis considered fair, either pounds, pieces, or any other convenient unit. The cost or rate applied to a piece going through the center is called a process rate. The total cost of the completed product is determined by scheduling the production centers through which the product passes, applying the rates for each center, and the sum of the rates is the cost of the product.

To obtain the absolute cost of any one lot of leather a lot report showing the cost of the hides and the yield of the leather is necessary.

Considering now the details of an appropriate cost practice for the tannery, the first element to be disposed of is labor. The payroll will be distributed weekly to the production centers. Since the payroll is largely figured by piece-rates, this is not a difficult problem.

It will be necessary to distribute the material consumed in the same way. All material purchased will be charged to a central stores account from which it will be charged in turn to the various production centers. Oil of vitriol, lime, and muriatic acid should be kept apart, but should be charged in the same manner. Bulk materials may be kept in storage rooms fitted specially for them, and in all cases must be considered as being in the storeroom until charged to a production center. The foreman in charge of each center will be allowed to keep on hand materials not to exceed one week's supply except in the case of soda ash, dried blood, and other items of which a single package may last indefinitely.

When the materials are received for the storeroom, the storekeeper will compute from information furnished by the purchasing department the cost per unit of each material and will average this cost with the cost of similar stores on hand from previous purchases. In this manner complete records will be kept by which to make accurate charges to the production centers.

The third element is overhead expense or burden. Each department of the plant will be charged for its proportion of floor space occupied. This is in the nature of a rent charge and must include all elements such as interest, taxes, land and buildings, depreciation, insurance and repairs. Each department also will be charged with the cost of maintaining the machinery used in that department. This charge includes interest and taxes on the investment in the machinery, depreciation, repairs, power consumed, and so forth. Each department also will be charged with its proper proportion of indirect labor such as foremen, superintendents, truckers, sweepers, and so on.

For the distribution of burden charges the factory has been divided into 35 production centers.

The following schedule enumerates briefly the processes through which hides are run.

Beam House. Soaking—milling—sulphide—wash—neutralize—wash—liming—wash—flesh—wash—puring.

Tan House. Weigh—wash—chrome liquor—strike out—dip—hypo—wash—horse.

Shaving Department. Splitting—shaving—stamp.[1]

Coloring Department. Weigh—color—fat liquor—wash—put out blacks—oiling (emulsion, oil—dry).[2]

Staking Department. Count—beat—stake (beating process).

Seasoning Department. Season—glaze—season—glaze (inspect after each glazing).

Sorting and Shipping Room. Measured by square feet—inspect—sort by grades.

In determining costs for each process it is necessary to take into consideration the fact that hides are purchased by the pound and that the finished leather is sold by the foot except in the case of sole leather, which is sold by the pound. For upper leather some basis must be found which will yield accurate results in spite of the fact that the hides gain or lose in weight materially while going through the different processes.

To arrive at this basis the production records of the company for several years past have been used. The total purchases of each different kind of hide have been averaged over a period of years to show the average number of square feet contained in each one dozen hides of each kind of leather. The following schedule shows that there is a decided variation in the average square-foot content of the different types of hide:

Kind of Hide	Average Square Feet per Dozen Hides
Patnas	45
Coconados	60
Deccans	65
Calcuttas	55
Czechuans	63
Hodeidahs	50
Cearas	72

After determining the average number of square feet contained in each type of hide, the total square feet of all kinds of hides processed

[1] At this point the lot number is perforated on one corner of every hide. All hides purchased on one invoice are given the same lot number so that the amount and quality of finished leather secured from the hides purchased on each invoice can be calculated for that invoice. These calculations serve as a basis for the purchasing department to estimate the quality of hides delivered by individual vendors.

[2] Upon the completion of this step the hides are in a hard, crisp condition in which they can be stored if necessary.

in each department each year was calculated from the production records, i. e., the aggregate square footage of hides passing through each center during a year was found. The capacity of each production process was determined in terms of total dozens of hides per year regardless of the particular kind of hide.

The cost of materials used in each process was worked out. For instance, in the liming operation it was found that an average of 50 dozen skins could be worked at a time. Sulphide, salt, lime, arsenic, and oripon are used for each batch of 50 dozen skins. The total cost of these materials is $10 per batch or 20 cents per dozen skins.

In the tan house it was found that one process required bichromate of soda and muriatic acid valued at 25 cents, for use with each 125 pounds of skins treated. It was known that 25 pounds is the average weight per dozen skins. There are, therefore, five dozen skins on an average which can be treated in each solution. The cost per dozen skins for this process was thus estimated to be 5 cents.

Seventy-five per cent of the processes were calculated on a pound basis, the other 25% on a dozen basis. In either case the average footage could be obtained readily.

Since all leathers do not go through the same processes, it is necessary to construct a schedule of material costs for each different kind of leather. These schedules furnish the necessary information on which the cost department can accumulate the tanning materials cost per dozen skins for each kind of leather produced.

The direct labor cost can be ascertained in the same manner for each process. In every department the normal output for a year is known to require a specific amount of direct labor, the value of which can be calculated and does not vary appreciably from one period to another. The cost per square foot is made up for each department and shown on the schedule outlined:

LABOR SCHEDULE

Department	Normal Production	Direct Labor	Schedule Cost per Foot
1			
2			
3			
4			
5			
Etc.			

Direct labor is paid on a piece-rate basis and if these piece-rates are set properly there should be no difference in a given operating period between the direct labor costs of handling the various kinds of leather. Large hides require more time for manipulation in each process, but they contain more square feet than the smaller hides which require less direct labor time. Since the ultimate costs are figured on a square-foot basis, the rates are approximately accurate regardless of the type of hide worked.

Burden charges for each department are placed on similar schedules on a square-foot basis.

As has been stated previously, every lot of hides received on one invoice is given a lot number and each individual hide is perforated with that number to facilitate the accumulation of the total costs of tanning. The invoice cost of each lot is reported by the purchasing department and is used for cost purposes in determining the value of finished leather resulting from the processes of the lot. Cost cards are kept for each batch of hides received on an invoice. The total costs are shown on a form the headings of which are:

DETAIL

Department No. 1 (2, 3, etc.)						Invoice No.		
Date	Lot	Dozen	Average Feet	Total Feet	Sched. Total Labor Cost	Sched. Total Material Cost	Sched. Total Burden	Total Sched. Cost

The form shown above is used in each department and contains cost data for all the lots processed in that department. The total costs of a particular lot are gathered on a summary by the cost department after all hides in one lot have been completely processed. The summarizing is carried out on a form for each lot number as illustrated:

SUMMARY

Lot Number

Department	Material	Labor	Burden	Total
1				
2				
3				
Date lot finished				
Total dozen				_____
Total feet		_____		
Estimated feet		_____		
Feet gained or lost		_____		
Estimated cost per foot				_____
Cost complete lot				_____
Net estimated cost				_____
Labor, material, overhead per dozen		_____		
Labor, material, overhead per foot		_____		

This summarizing is done after the finished leather from each invoice of hides has been delivered to the sorting and grading room. The

actual number of square feet of leather obtained from each lot is measured; the actual footage is entered on the summary sheet and makes possible the calculation of the feet gained or lost in tanning the lot. This definite figure is used to obtain the estimated cost per foot and the complete cost of the lot using the schedule costs per unit applied to the actual footage of leather finished. Up to this point the schedule costs for each square foot of finished leather have been calculated; although the cost of each square foot of leather obtained from a given lot is the same, there are decided variations in size, weight, and quality of the hides. It may happen that from one lot of hides purchased on the same invoice no two pieces of finished leather will be of the same selling quality.

The final step in the costing is intended to establish an index of the differences between the finished pieces of leather obtained from one lot. In the sorting and grading room the finished hides are sorted according to size, weight, and quality. As each individual lot is completed the number of feet in each grade is listed by grade groups. In each group are included the finished hides which the inspectors have determined to be of the same selling quality. The total point value [1] of each grade group will be determined by multiplying the total number of square feet in each group by the point value. The grades with their relative selling values are listed in Table I.

TABLE I

RELATIVE SELLING VALUE BY GRADES

Grade	Point or Relative Value	Grade	Point or Relative Value
31	60	61	45
32	55	62	40
33	50	63	35
34	45	64	30
35	40	65	25
36	35	66	20
37	30	67	15
38	25	68	10
39	20	69	5

The total cost of a lot divided by the total point value of the lot equals the cost value of one point; five of these points are taken as the value of grade group Number 1.[2]

The other grade costs are then determined from the value of group Number 1.

[1] The "point value" is the relative selling value of a grade group of finished hides. They are determined by the sales department on a basis of past experience.

[2] A grade group contains all grades having the same relative values.

To compare one lot with another it is necessary to determine the average grade of each lot. This can be done by dividing the total point value of the lot by the total number of feet.

Any change in the relative values between grades will make it necessary to transfer some grades from one grade group to another or to increase or decrease the number of grade groups so as to maintain a uniform differential between grades.

The relative values of the different grade groups as governed by the selling values of each group are shown in Table II.

TABLE II

RELATIVE VALUE BY GRADE GROUPS

Point or Relative Value	Grade Groups	Point or Relative Value	Grade Groups
60	12	30	6
55	11	25	5
50	10	20	4
45	9	15	3
40	8	10	2
35	7	5	1

The relative values of different grades in each grade group are brought out in Table III.

TABLE III [1]

GRADES CONTAINED IN EACH OF THE TWELVE GROUPS

12 / 31	11 / 32	10 / 33
9 / 34, 61	8 / 35, 62	7 / 36, 63
6 / 37, 64	5 / 38, 65	4 / 39, 66
3 / 67	2 / 68	1 / 69

This table shows that grade Number 35 is worth eight times as much as grade Number 69, and that grade Number 39 is worth four times as much as grade Number 69 or one-half as much as grade Number 35.

The variation in value between the different grades is worked out in percentages as a basis for calculating the selling prices. The percentage of each grade to each other grade is calculated from their rela-

[1] Upper figures are grade groups. Lower figures are grades contained in the indicated group.

tion to the average or to grade group I. Table IV illustrates the final calculation of the differential between these as compared with each other and grade group I.

DIFFERENTIALS BETWEEN GRADE GROUPS [1]

Grade	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	.50	.33⅓	.25	.20	.16⅔	.143	.12½	.11	.10	.09	.08⅓
2	2.00	1.00	.66⅔	.50	.40	.33⅓	.286	.25	.22	.20	.18	.16⅔
3	3.00	1.50	1.00	.75	.60	.50	.429	.37½	.33	.30	.27	.25
4	4.00	2.00	1.33⅓	1.00	.80	.66⅔	.572	.50	.44	.40	.36	.33⅓
5	5.00	2.50	1.66⅔	1.25	1.00	.83⅓	.715	.62½	.56	.50	.44	.41⅔
6	6.00	3.00	2.00	1.50	1.20	1.00	.858	.75	.67	.60	.54	.50
7	7.00	3.50	2.33⅓	1.75	1.40	1.16⅔	1.000	.87½	.78	.70	.64	.58⅓
8	8.00	4.00	2.66⅔	2.00	1.60	1.33⅓	1.143	1.00	.89	.80	.73	.66⅔
9	9.00	4.50	3.00	2.25	1.80	1.50	1.286	1.12½	1.00	.90	.82	.73
10	10.00	5.00	3.33⅓	2.50	2.00	1.66⅔	1.429	1.25	1.11	1.00	.91	.83⅓
11	11.00	5.50	3.66⅔	2.75	2.20	1.83⅓	1.572	1.37½	1.22	1.10	1.00	.91⅔
12	12.00	6.00	4.00	3.00	2.40	2.00	1.715	1.50	1.33	1.20	1.09	1.00

The foregoing plan was adopted by the company and put into effect early in 1921. The books used in the cost accounting were closed each month and variations between the standard costs and actual costs as shown in charges overabsorbed or underabsorbed were corrected by entries to the general overhead account. Changes were made as necessary to compensate for variations in the cost of tanning materials and direct labor. The total annual variations between schedule and actual costs were so slight as to be negligible. The company continued to operate this cost system with satisfactory results.

34. THE OWSLEY SHOE COMPANY—COST SYSTEM FOR SHOE MANUFACTURE

The Owsley Shoe Company manufactured medium-price welt shoes for women. It operated three factories with a daily production of 8,000 pairs. The number of styles made annually varied from 3,000 to 4,000. All shoes were sold before they were manufactured, and practically no special-order business was accepted. Shoes went through the factory in 36-pair lots. Each lot was placed on a rack which consisted of six tiers of shelves, each shelf holding six pairs. The transfer from one department to another and from one operation to another was

[1] This table shows, for billing purposes, the relation in percentages of each grade group to the others. For example, grade group No. 3 (left-hand column) is shown as worth, in selling value, 150% of grade group No. 2, 60% of grade group No. 5, and 25% of grade group No. 12.

made by moving the racks. In order to speed up production and to keep each rack full, orders were collated upon receipt and shoes were grouped by styles for the factory runs. This permitted the workers to become familiar with one style before transferring to another.

Manufacturing Processes

A shoe passed through the following 12 departments in its manufacture:

1. Upper Leather Cutting
2. Linings and Trimmings
3. Stitching
4. Last House
5. Lasting
6. Sole Leather
7. Heel
8. Making
9. Finishing
10. Treeing
11. Packing
12. Shipping

1. *Upper Leather Cutting.* The upper leather required for each order was requisitioned from the central storeroom by the production department after the collection of orders, and sent to the upper leather cutting department where it was held in an intermediate store in the center of the department until given to the operator. Upper leather was cut both by hand and by machine. Dies were used for machine cutting and patterns for hand cutting. Die patterns were kept in this department, and pattern boys took each cutter's requirements to him and removed them from the machine back to the die stores. The machines used for cutting were of two types; one was called a clicker and the other a beam dinker. The clickers were leased, whereas the beam dinkers were owned by the company.

When a cutter completed the requirements for one case of shoes, he tied them into a bundle and sent them to the intermediate stores by a pattern boy. Here they were sorted by table boys, and the different parts—vamps, quarters, tops, and foxings—were grouped together in preparation for stitching.

In this department also occurred the skiving operation which trimmed the sewing edges of each piece of upper leather in order that the joint might not be too abrupt. If the upper leather material was ooze calfskins, it was backed by pasting on a rubber material which helped to retain the shape of the finished shoes.

Each piece then was stamped with its case number so that it

might be followed through the factory. All operators in this department were paid on piece-rates.

2. *Linings and Trimmings.* The operations in this department were the same as in the upper leather cutting department. Linings and trimmings were cut by clickers and beam dinkers. Cloth linings were cut for the toe of the shoe, and leather linings for the quarters. For shoes made of light stock a flannel doubler also was cut which extended as far back as the leather quarter lining, and was placed in the shoe between the lining and the upper leather. Buckrams or underlinings also were cut in this department. Furthermore, if the shoes were to be made of smoked horse, elkskin or ooze skin, paper covers were cut to protect them in the manufacturing processes. Laborers in this department were all on a piece-rate, and a few of the best cutters were guaranteed a definite amount. If their piece-rate did not equal the guarantee, they were paid the fixed sum. If they exceeded the guarantee, no bonus was paid.

The linings and trimmings were cut by the use of both dies and patterns. Dies were not purchased for upper leather cuttings or linings and trimmings unless the company was certain that at least 16,000 pairs of shoes would be made from these dies.

In the linings and trimmings department, the linings were stamped with the size, width and case numbers, and also numbered to denote whether they belonged to the spring or fall run, since style numbers were changed each season.

The last operation in this department was the cutting of sock linings. These linings were made of thin leather and were pasted in the finished shoe over the in-sole.

The only indirect labor in this department, other than supervision, was for table boys, who sorted the work and made it ready for the stitching department.

3. *Stitching.* From the upper leather cutting department and the linings and trimmings department which were located on the first floor, the cut upper leather and linings were sent by elevator to the stitching department located on the fourth floor. The cut upper leather was placed in an intermediate store in this department and given out as needed to the operators.

The operations in this department varied according to the style of the shoe. For a standard black oxford there were generally 10 operations—seaming, staying, making, lining, perforating, fancy stitching, tip stitching, vamping, eyeleting and filling with temporary lacings. Other operations on different styles included fancy perforating, barring, sewing on French cord, sewing on buckles and buttons. Altogether, in this department, there were over 40 possible operations.

The majority of the operators in this department were paid piece-rates. In some instances, however, shoes were manufactured before piece-rates had been set for them, and laborers were paid by the day until the piece-rate was fixed. Several of the minor operations also were paid on a day basis.

In this department the linings were sewed together in the same way as the upper leather, and each upper received its lining. The materials used included thread, wax, cement, eyelets, chalk, buttons, buckles, tape (for stays), perforated paper, and oil.

The uppers, linings, and trimmings then were bagged and sent to the last house.

4. *Last House.* In the last house the cut uppers, linings, and insoles were sorted according to last requirements and date of shipment. It was difficult to have lasts for each style of shoe. Whenever possible old lasts were utilized, and for this reason a skilled supervisor was in charge of the last house. When the time came for the manufacture of the shoe to proceed from this point in order to be ready by the requested shipping date, the lasts were placed on a rack, together with the uppers, insoles and linings, and sent to the lasting department.

5. *Lasting.* Eight operations were made on the shoe in the lasting department. The in-sole was tacked to the last; then the shoe was assembled by placing the upper over the last, putting in the counter and tacking these to the last. The "pulling over" machine then pulled the upper leather tightly over the last and tacked it in place. The sides of the upper were straightened and tacked in place. The bedding machine next completed the fixation of the upper to the last by pulling the quarter tightly over the back of the last and nailing it in place and by affixing the toe wire around the pulled-over ends of the tip. The

upper leather and lining were stapled together, and the long tacks which had been holding these together were then pulled so that they would not interfere with the stitching machine. Lastly the shoe was toe-trimmed—that is, the excess edges of upper leather and lining were cut off. If the shoe was made of ooze, smoked horse, or elk it received its covering of paper at this point.

6. *Sole Leather.* Sole leather was cut, graded, and kept in stock. In addition cut soles also were bought. Soles were cut by sizes and run through a machine which measured the thickness of the sole in irons[1] and stamped on each the number of irons it contained. They were sorted into three grades according to their condition and put in racks by grades and irons. The soles which were bought outside received an additional process of skiving which pressed the soles and made their thickness uniform. The practice of cut sole suppliers, to grade the soles by eye, made this operation necessary. The last operation on soles was shanking out, by which a portion of the leather was cut away from the center of the sole in order to make it more flexible.

Requisitions came to the sole leather department from the production department at the same time requisitions were sent to the upper leather storeroom. Sole leather was taken from the racks according to the specifications on the order, tied together and sent to the making department.

Half the sole leather department was devoted to the cutting of inner soles. These also were purchased in some quantities already cut.

Two kinds of inner soles were made; one was all leather, the other was leather with a backing of canvas. The operations for making the inner soles consisted of cutting by machines, heel scouring and sizing, toe snipping (which made three cuts in the end of the insole so that there would be no strain when a channel was turned up for the sewing on of the welt), and channel cutting which turned up an edge of the sole all around to enable the Goodyear welt stitcher to sew the in-sole, upper and welt together. After the soles were sewed on, the channel was laid down and cemented, which retained a smooth surface of the

[1] An iron is 1/48 of an inch.

sole. The next operation was for the soles which received a canvas backing and was called canvas forming. After receiving the backing of canvas the sole received an operation which trimmed off the excess canvas. The soles which were made entirely of leather were soaked in water and the channel was turned up while wet and dried in position without stitching. The last operation then was received by both types of soles and was called stapling butts. This clinched together the raised channels and assured them of staying in position.

The materials used in this department were flexible side leather, nine-ounce duck, thread, and staples. The laborers on the channeling machines, trimming machines and canvas forming machines were paid by piece-rates, while the others were on a day basis.

7. *Heel.* The company manufactured its own heels. A portion of the material used in this department came from the scrappage of the out-sole cutting department. Pieces for the heels were cut by hand and by beam dinkers. The pieces were assembled, cemented and nailed together, and run through a grading machine for sizing. They then were stored until called for by a production order upon receipt of which they were bagged and sent to the making department.

All workers were paid by the day.

8. *Making.* Twenty-two distinct operations were performed in the making department.

Operation	Description	Wage Payment
1. Welting	The welt was a strip of leather sewed to the bottom edge of the upper and through in-sole channel. When the out-sole was put on, it was sewed to the welt.	Piece-rate
2. Tack Pulling	Part of the tacks which held the upper leather to the last were removed.	Day-rate
3. Seam Trimming	The last excess of upper leather and lining next to the welt was removed.	Day-rate

Operation	Description	Wage Payment
4. Beating Out Welts	Preparing the welts for sewing on the soles.	Day-rate
5. Tacking Shanks	The shank was a combination of leather and metal tacked on the in-sole at the fore-part to maintain the arch between heel and ball.	Day-rate
6. Bottom Filling	The area between the in-sole and the top edge of the welt was filled with a combination of cork and rubber.	Day-rate
7. Molding Out-Sole	The out-sole was stamped and molded to make the arch.	Day-rate
8. Cementing Bottoms	The sole was cemented, laid and attached to the shoe.	Day-rate
9. Rough Rounding and Channel Cutting	The excess portions of the out-sole were cut off, and a channel cut in the out-sole so that after the sole was sewed on this could be relaid and the seams would not be on the outside.	Piece-rate
10. Goodyear Stitching	The sole was sewed to the welt.	Piece-rate
11. Cementing Channels	Channels were cemented and relaid over the seams of the bottom of the sole.	Day-rate
12. Nailing Heel Seat	A row of nails was driven through the outer sole and inner sole around the heel seat.	Day-rate
13. Rounding Heel Seat	The excess out-sole leather was trimmed around the heel.	Day-rate
14. Leveling	Bottoms of the shoes were rolled to conform to the last.	Day-rate
15. Heeling	The heel was tacked on.	Piece-rate
16. Slugging	The top of the heel piece was put in place.	Piece-rate
17. Heel Shaving	The excess of the heel top was removed.	Day-rate
18. Breasting Heels	The inside of the heel was rounded.	Day-rate

Operation	Description	Wage Payment
19. Scouring Heels	The heel was sandpapered down.	Piece-rate
20. Edge Brushing	The edges of the soles and heels were brushed and sandpapered.	Piece-rate
21. Scouring Heels	Same operation as Number 19.	Piece-rate
22. Edge Setting and Staining	The sole edges were trimmed and stained.	Piece-rate

In addition to the heels and soles which this department received from the heel and sole departments it used such material as thread, blacking, slugging wire, nails, welting, cork and rubber filler, shanks, and rubber heel tops.

9. *Finishing.* The operations required for finishing shoes varied according to the bottom finish. Some shoes were finished with a rough bottom, some with a natural stain, and others stained black or white. The main operations of the department were bottom scouring, which sandpapered the out-sole; naumkeaging, which was a continuation of the scouring process; bottom staining; and heel finishing, which brushed and polished the heels. Following this the temporary string laces which had been inserted through the eyelets by the stitching room were cut and the thread ends left on the shoes in stitching room were burned off. The final operation was last pulling, which removed the last from the shoe. From the finishing department the lasts were returned via chute to the last house.

Materials used in this department were stain, sandpaper, dies, wheel brushes and wax. The wage payments were on a day basis.

10. *Treeing.* There were seven operations in this department. The sock lining was put in and pasted on top of the inner sole. The bottoms then were stamped with the trade-mark of the company, or in the case of large shipments, with the name of the purchaser. If shoes had been covered, the paper covers were removed. The shoes then were treed, cleaned and ironed. Final inspection occurred at this point, and after this inspection the shoes were laced; if they were made of patent

leather they were flamed. A fluid was used to give the leather an added lustre and to conceal minor defects in the upper.

All labor in this department was on a day basis except the treeing operation which was paid for by the piece. From this department the shoes were sent to the packing department. Materials used in this department were sock linings, glue, dies, benzol, other cleaning reagents, and gold leaf.

11. *Packing.* If slight imperfections were found in the shoes which could be rectified easily, this repair was made in the packing department. Badly damaged shoes were thrown out and sold at a reduction as "factory damages." The shoes then were brushed for a final cleaning. The cartons were stamped with the company's or the buyer's label, and the shoes packed in them for shipment.

Materials used in this department were cartons and tissue paper. The labor was all on a day basis.

12. *Shipping Department.* After the shoes were packed and sent to the shipping department they were boxed in cases, nailed and marked for delivery.

Materials used in this department were cases, nails, binding wire, and for the export trade, waxed paper.

All labor was on a day basis.

The approximate percentages of the total cost of a shoe for material, labor, and burden were as follows:

Material 55% Labor 34% Burden 11%

The principal elements of burden in the order of their importance were the production department, the cost department, the payroll department, superintendence, depreciation, insurance, and taxes.

Six problems in measuring efficiency confronted the executives of the Owsley Shoe Company. The first and most important was to obtain correct costs to help to set a proper selling price. The field in which the Owsley Shoe Company operated was intensively competitive, and business was done on a narrow margin. Because of the many styles manufactured by the company, determination of correct costs was difficult. It was desirable that correct costs be figured daily, for with a daily pro-

duction of 8,000 pairs a slight discrepancy rapidly amounted to a large figure.

Greater efficiency in the cutting room was especially desirable. Proper checks on the performance of each cutter were made difficult because of the great number of styles of shoes and the various types and grades of leather used.

The stores of the Owsley Shoe Company were divided. Upper leather was kept in one place and all findings, threads, and buckles, were kept in a general store. Occasionally an order would be held up by the absence of proper findings.

In practically every department, there was piece and day labor, and productive and unproductive labor. More correct application of this was desirable.

The last problem which the executives desired to have solved by a proper cost accounting system was that of distributing the cost of lasts, dies, and patterns. It was not economical to have dies made for cutting upper leather or linings unless 16,000 pairs were to be cut from the same die. In some instances, more than 16,000 pairs were cut from each set of dies. Opinion was divided as to whether or not the costs of the die should be distributed over the first 16,000 pairs cut. If this method were followed, those shoes which were made later from these dies would not show the same cost. Patterns were made for the styles of which it was believed less than 16,000 pairs would be made. In charging off last costs, it was difficult to forecast the life of a last. Lasts were bought for one style, and after this style had become obsolete, the lasts were stored. Whether or not they could be used later was a matter of chance. They might be stored for two or three years and not used. It was difficult to know which styles to retain.

Devise an accounting system suitable for the fixation of the proper costs for the Owsley shoe plant.

35. COLEMAN SHOE COMPANY—SPECIAL ORDERS

The Coleman Shoe Company manufactured men's welt shoes of a high quality. The manufacturing operations were practically the same as those described in the Owsley Shoe Company problem. The factory racks of the Coleman Shoe Company, however, had a capacity of only 24 pairs instead of 36 pairs.

The output of the Coleman Shoe Company was approximately 3,500 pairs daily. Fifty per cent of the shoes manufactured were marked with the customer's name on the sole and on the sock lining. In addition, on some of the shoes, a label on which the customer's name appeared was sewed to the top of the lining. The company normally had 125 styles annually, and in over 60% of the shoes made the samples did not exactly satisfy the customer, and minor changes were allowed. These changes took the form of extra perforating, fancy stitching, and so on. As a result of these two production factors, the Coleman Shoe Company made a practice of running sales orders through the plant as production orders. The average order was 12 pairs, and in many instances, fill-in orders were for six, three, or even one pair.

What changes from the system recommended for use by the Owsley Shoe Company should have been made to fit the needs of the Coleman Shoe Company?

G. OTHER INDUSTRIES

36. ORIOLE GAS COMPANY—ACCOUNTING FOR GAS MANUFACTURE

THE Oriole Gas Company manufactures both coal gas and water gas. Although the company has found that it is frequently cheaper to manufacture water gas, the cost fluctuates with the changes in the price of the oil used, since only a low price can be obtained for residuals from this process. As a consequence the firm is convinced that the cost of the manufacture of coal gas is more stable.

It requires 2.8 gallons of oil to manufacture 1,000 cubic feet of water gas. Since this oil costs about 5½ cents a gallon, the cost of oil for each 1,000 cubic feet of gas is about 15.4 cents. In addition the 30 pounds of coke used in the generator cost about 14 cents; the 12 pounds of boiler fuel cost about 4 cents; and the labor required costs about 8 cents. This makes a total cost of approximately 41 cents a thousand cubic feet, and the only residual obtained is one-third of a gallon of tar, which sells at between 4 cents and 5 cents a gallon. Coal gas, on the other

hand, costs about 60 cents a thousand cubic feet, this cost being principally for gas coal, but the residuals, tar, coke, and ammonia, are of considerable value.

The process of manufacturing water gas requires three principal pieces of apparatus, the generator, carburetor, and superheater. Coke, hauled from the coal gas plant, in the company's own automobile trucks, is fed into the generator through an opening at the top, a charge consisting of a measured amount of a little over one-half ton. Through an opening at one side near the bottom, a mechanical blower sends a stream of air in through the coke which has first been ignited. After three minutes the air is shut off, and steam is run through the coke for four minutes. The combination of steam and coke, or carbon and water, produces hydrogen and carbon dioxide, or hydrogen and carbon monoxide. An attempt is made to keep the amount of carbon dioxide at a minimum. The product of the generator, known at the plant as blue water gas, is the equivalent of about 300 British thermal units per foot.

In the carburetor, to which this gas next passes, it is mixed with a quantity of oil, so that by the time the mixture leaves the superheater, into which it passes from the carburetor, it has a content sufficient to meet the state's requirement of 528 British thermal units per foot. From the superheater the gas passes through a wash box, filled with enough water to prevent the gas receding, into a relief holder, whence it is drawn by an exhauster into the purification process. In this process, the gas first runs through a condenser, then through a tar extractor, and finally through iron oxide and wood shavings, which lie four feet thick in wooden trays. The iron oxide is spread in the yard for revivification after having been used. After purification, the gas passes through a meter into the distribution holder. The holders, or gas tanks, familiar to everyone, are inverted in a basin filled with water, and move up and down according to their gas content.

A gang of 20 men is sufficient to manufacture the average output of 1,500,000 feet of water gas a day, whereas over 50 men are required by the same company to produce a million feet of coal gas in a like period. Of the 20 men 3 are gas makers, whose principal work is to feed the generators and watch the indicators. They are assisted by 3 helpers, who bring the coke to the gen-

erators. Three engineers and 3 firemen are required to run the engines, pumps, and boilers. Since the plant runs 24 hours each day, there are three 8-hour shifts. A spare gas maker is engaged usually in maintenance, in addition to one man who is engaged in maintenance exclusively. Five men clean fires, cart ashes to the dump, do general cleaning, and handle the iron oxide purifier. In order to insure the prompt removal of ashes from the dump throughout the year, they are given away and not sold. The water gas plant is in charge of a general foreman.

All coal which is used in the manufacture of coal gas is received on the company's own wharf where it is unloaded from the barges by means of a mechanical hoisting apparatus. As the coal passes over a belt conveyor from the wharf to dry storage in a building called a "bottle" or "silo," a sample, approximating 1½ tons for each shipment of 1,500 tons is taken from the belt for analysis. This sample is crushed, and about 15% of its amount is taken to the laboratory, and is reduced still further to from four to eight ounces before being subjected to analysis, which usually shows about 1% moisture content, 34% volatile matter, 57% fixed carbon, and 8% ash.[1]

The principal part of the manufacture of coal gas takes place in the retorts. A belt conveyor carries the coal from the dry storage in the bottle to a hopper on the upper floor of the retort, on which it is deposited mechanically. A traveling larry, which is moved by power and is provided with scales, receives the coal through gravity for the charging of the retorts. The retorts are arranged in three rows of three each, comprising a "bench," of which there are seven. Eighteen hundred pounds of coal are passed into each retort at each loading, about 30 minutes being required for loading all the retorts. Heat is applied to the retorts from "producers," or large furnaces. As this heat circulates through the retorts, the coal is baked or carbonized, and the gas passes off through a hydraulic main and a foul main at a temperature of about 200°F, into the primary condenser, from which it emerges at a temperature approximately 90 degrees lower. From the primary condenser the gas goes through the exhauster and the tar extractor, from which it passes into the secondary condenser, where it finally reaches a temperature of about 65°F.

[1] In 1922, this coal cost about $2.75 per short ton at the mine or $6.80 per long ton at the dock.

From this point it passes through the emersion washer, the scrubbers, and the iron oxide purifier before it is metered into the distribution holder, from which it passes through a governor regulating the flow into the street mains.

When the coke leaves the retort it is carried by a belt conveyor to a series of shaker screens over which it is passed to separate it according to size. It is then left in the yard until sold or needed at the water gas plant, or for the producers. Half the ammonia comes off in the hydraulic main and half in the ammonia scrubbers, which are just ahead of the purifiers in the process. Tar comes off at different points, although the bulk of it comes off in the hydraulic main. These by-products are valued at their approximate selling figure in the open market. The sale of the residuals results in a large income to the plant.

Control of the production processes is obtained through daily performance records which are sent to the home office. Since the plant has been long in operation, the management knows approximately what the output should be, and the plant superintendent is able to set up standards.

There is comparatively little waste of materials, although in the water gas process, a small amount of gas is allowed to escape into the air from the superheater at the end of each run, and some gas in the coal gas process escapes through the tops of the retorts when they are opened for charging.

As the coal gas plant is also in operation during the entire 24 hours of the day, three shifts are necessary in many places, especially in the retorts. Three firemen and three engineers care for the engines, pumps, producers, condensers, and other machinery. Fourteen men are employed at the retorts, four gas makers on each shift and the night and day foremen. Of the four gas makers on duty at a time, one who is known as a "shaker man" screens the coke; another is a top operator engaged in charging the retorts with coal; a third is a bottom operator who opens the lower doors and takes out the coke; and a fourth, known as "the buggy man," assists the operator in removing the coke. A hoister and a helper are employed to unload the barges mechanically and to move the coal from the dock to the belt conveyor. A piper and an assistant and a machinist and an assistant are engaged in making repairs. The blacksmith and his assistant make the repair parts. Twelve laborers, who shovel

iron oxide, coal, and coke, and clean the yard, are under the direction of a foreman. An ashman spends his whole working time carting ashes from the producers, and cleaning. One man keeps the hydraulic main clear of tar. A centrifugal man separates the water from the tar. The remaining employees are the master mechanic and his shop crew, the chemist and his assistant, the chief clerk, the coal checker who weighs coal in and out, and the general foreman in charge of the plant. With the exception of the foremen, chief clerk, and chemist, who work on a monthly basis and are paid semimonthly, everyone punches a time clock and is paid by a paymaster in the middle of each week for the work of the preceding week. The chief clerk reports the time of each man for each day to the home office.

The following statements give the general facts relating to the operations of the company.

MANUFACTURING AND TRADING ACCOUNT, ORIOLE GAS COMPANY

Coal and Oil — including handling	$900,000		Sale of Gas:		
Purifying Materials and Wages	18,000		Lighting and Domestic	$800,000	
Works Salaries	19,000		Manufacture and Power	360,000	
Wages, Carbonizing	120,000				$1,160,000
Repairs and Maintenance	200,000		Sale of Residuals:		
Depreciation	90,000		Coke, less Labor and Cartage	$450,000	
Taxes	80,000		Tar	65,000	
Total Manufacturing Cost		$1,427,000	Ammoniacal Liquor	105,000	
Salaries, Inspectors and Clerks	$ 25,000		Sundry Residues	25,000	
Repairs and Maintenance, Distributing System	30,000				645,000
Repairs to Meters	16,000				
Total Distributing Cost		71,000			
Balance, to Profit and Loss		307,000			
		$1,805,000			$1,805,000

PROFIT AND LOSS ACCOUNT

Administrative Expenses	$ 14,000	Balance from Trading	$307,000
Bad Debts	1,000	Rents	12,000
Legal Expense	24,000	Discounts on Purchases	3,000
Pension Funds	6,000	Interest	9,000
Balance, Net Profit	286,000		
	$331,000		$331,000
		Balance	$286,000

PRODUCTION FIGURES

Tons of coal used	120,000
Gas produced, cubic feet	1,200,000,000
Coke produced, tons	80,000
Coke used in plant, tons	10,000
Coke sold, tons	70,000
Coke sales, value	$540,000
Coke handling expense	$ 90,000
Coke sales, net return	$450,000
Ammoniacal Liquor, tons	9,000
Tar produced, gallons	1,200,000

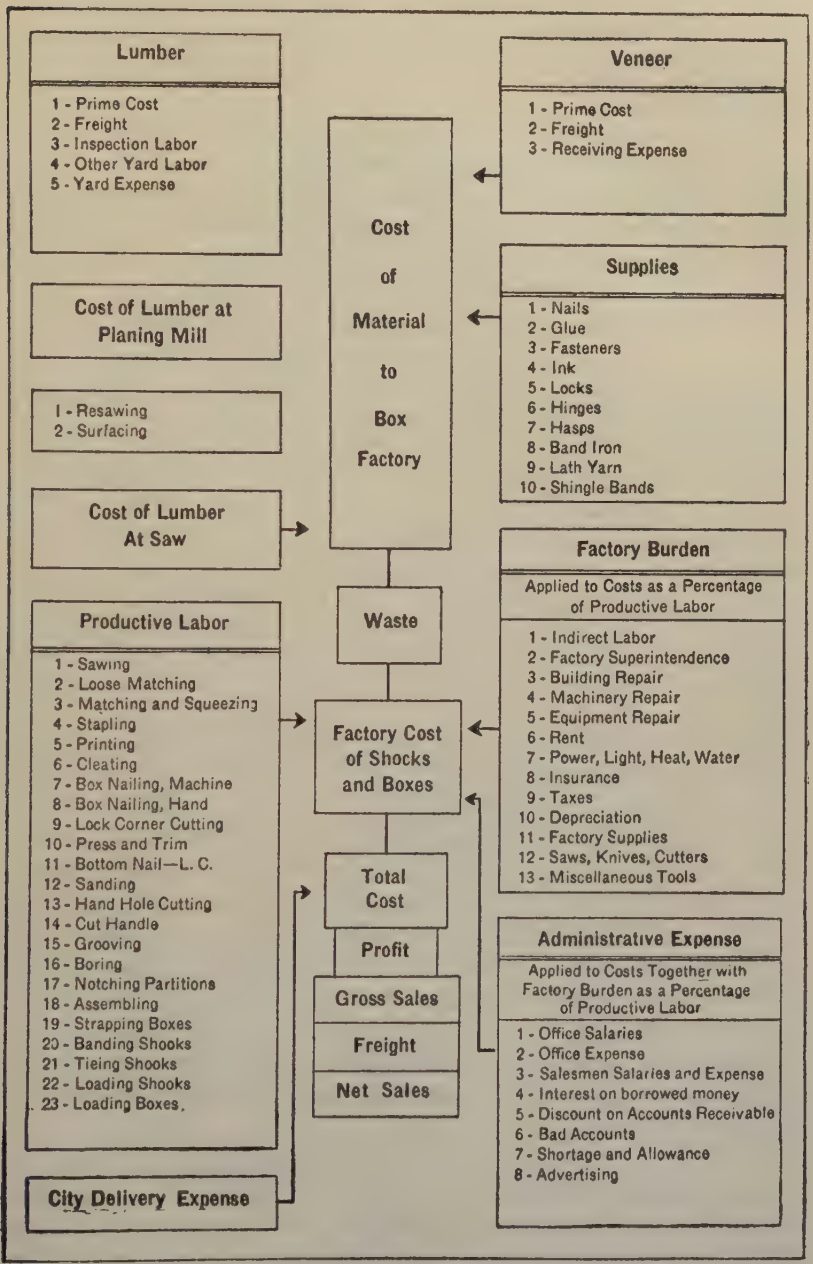
37. THE MONROE BOX COMPANY—COST SHEET

The Monroe Box Company makes practically its entire output in standard sizes and to standard specifications. On the other hand, it does not manufacture for stock because it wishes to avoid the heavy expense of carrying an inventory of finished goods. Customers' orders for similar boxes are frequently grouped together to form one factory order, and as the number of different types of boxes made by the company is considerable, the number of separate production orders put into the factory during one month for any one type of box is quite small, usually not more than twelve or fifteen.

A complete classification of expenses has been obtained by the Monroe Box Company from the National Association of Box Manufacturers, of which the company is a member; the classification is shown in Form 43.

Records are kept for all operations of productive labor, and of those done by machine, which records show the precise amount of time spent on each operation for each production order.

A certain amount of waste of lumber occurs on each production order. This has been standardized for each type of box, most of the figures ranging from 10 to 20% of the amount of rough lumber used. To simplify arithmetic on this point, it is customary to have a standard figure representing the amount of lumber acually contained in the finished product as a percentage of the total rough lumber used for that purpose. Thus, if 10% is waste, 90% is good. The quantity of lumber contained in the finished article is then computed as the basis for costing, this quantity being multiplied by the usual price for such lumber, and the total so obtained is divided by 90%, which has the result of increasing the lumber cost to include the waste. Factory burden



Reprinted by permission of the National Association of Box Manufacturers, from their *Uniform Cost Finding Plan*, page 8.

Form 43: Cost Chart

and general administrative expense are added separately as percentages upon the direct labor cost, the former being 90%, and the latter 40%.

Design a cost sheet which will conveniently summarize the costs entering into one type of these boxes. It is understood that a separate card will be used each month for each type of box, to cover all the boxes of that type made during the month, with the selling price of them and the profit or loss made.

38. THE JONES CLOCK COMPANY—ACCOUNTING FOR WATCHES AND CLOCKS

Practically the total output of the key-wind and automatic clocks of the Jones Clock Company is made to order, with the exception that when one or two clocks of a standard type have been ordered by a customer, the company may decide to manufacture a half-dozen. Branch selling offices are maintained in New York and Chicago, but a selling staff of six or seven is sufficient to dispose of all the clocks that the 70 factory employees can produce. The company owns a brick factory building 50 feet wide by 100 feet long, consisting of a basement and five stories.

Power for the whole factory is generated by a boiler located in the basement. Since the coal storage capacity is limited to a bin 32 feet by 20 feet, and the consumption is comparatively small, coal is bought by the truck load. The engineer, who attends to the firing, carts the coal from the bin in a wheelbarrow. Another section of the basement is given over to storage for castings, the iron frames upon which tower clocks are hung. These castings, which are bought from a foundry, are smoothed or snagged and painted at the factory. The snagging, which generally takes about a day for each clock, is done with an emery wheel with a flexible shaft, although a little hand filing is sometimes necessary. Old material and junk are also kept in the basement storage bin until sold.

Since the clocks are made to order, frequently according to architects' specifications, it is necessary to make clock cases at the factory. Wood for this purpose, principally oak and mahogany, is kept in a one-story drying shed adjacent to the first floor of the main factory building where the wood-working ma-

chinery is located. This machinery is simple, even sandpapering being done by hand. Waste wood is given to the watchman.

A space 15 feet wide by 24 feet long on the ground floor is reserved for the shipping and receiving department, where one man is employed. As soon as an order is received, it is rewritten in factory language, and a copy of the job order is sent to each department involved. No tags are at present used to trace the progress of the orders, although plans have been made to install a tag system in the near future. When supplies are to be purchased, a department requisition is made out in duplicate form giving the name of the firm to which the order is given, the date when ordered, the order number to be charged and the number of the requisition. This requisition is signed by the foreman and sent to the general superintendent and the superintendent of production who handles the purchasing at the main office.

As soon as the purchase reaches the receiving department, where it is weighed on a platform scale, if necessary, it is identified by the duplicate of the department requisition and is sent with the duplicate to the department where it was originally ordered for acceptance. The duplicate department requisition, showing the acceptance of the purchase, and a report from the receiving clerk are then sent to the office for bookkeeping purposes. All shipments from the factory are weighed as they leave, so that comparisons may be made with the railroad freight weights. Inward freight is charged as part of the purchase price on goods entering process.

The main office occupies a space 21 feet wide by 36 feet long. In addition to the general superintendent and production superintendent, there are in this room a bookkeeper and three girls who do stenographic, clerical, and payroll work. The remaining space on this floor is given over to storage which at present is being reorganized in order to install a modern bin and tag system. A freight elevator and stairway connect the six floors of the building.

Practically all work on tower clocks, which are large and heavy, is done on the second floor. The parts which are constructed from bar and sheet stock of iron and brass are made on small machines or by hand. The clocks are assembled on this floor and are adjusted by changing the length of the pendulum

by means of a screw until it is found that they are accurate within a minute a month. Three or four tower clocks are turned out each month. On this floor there is an office for the foremen and a storeroom from which supplies are issued only upon requisition.

Both the manufacture and storage of parts for smaller clocks are confined to the third floor. After the parts have been punched out of sheet metal by a press, irregularities are filed off by hand. Clock wheel teeth are cut by small milling machines. Arbors, connecting rods for the front and back plates, are made on small watch lathes. From 300 to 400 wheels or pinions for standard small clocks are turned out in one lot. There are from 40 to 50 pieces in the average small clock. Most of the labor is concentrated in cutting of teeth and assembling. Since the factory is comparatively small, it is seldom that a man does identically the same work throughout a day; many of the workmen, being old-time watchmakers, are able to make several different parts of the clocks. The small clocks are assembled on this floor prior to being taken to the fifth floor for inspection before leaving the factory.

On the fourth floor there is space for polishing, grinding and plating. Here also the electric clocks, exclusive of electric tower clocks, are assembled and tested. A small room on this floor is occupied by the new drafting department, but the remaining space is used for assembling hairsprings and escapements, which are used in the smaller clocks made on the third floor.

On the top floor, the largest room, which is 31½ feet wide by 57 feet long, is used for painting and finishing cases. These cases are stored in an adjacent room, 20 feet wide by 22 feet long. A dial painter's room and a storeroom for semifinished cases are also on this floor. The remaining space is used for the rigid inspection of small clocks before they leave the factory.

The management estimates that almost 50% of the total manufacturing cost is for labor, almost 40% is for burden, and the remainder represents the cost of materials. The methods now employed at the plant are in many respects obsolescent, but the management is trying to modernize the manufacturing processes as rapidly as possible. Lately a time clock has been installed, from which an office clerk removes the cards each day and computes the wages of each person for the payroll. The

factory employees, who are all on an hourly basis, are paid to the nearest tenth of an hour. On each Friday, the employees are paid for the week ending on Wednesday.

At the present time, the management is trying to find a suitable method by which to measure the burden on each clock produced. It believes that the overhead should fluctuate fairly closely with the direct labor-hours, or man-hours, but if an investigation does not bear out this theory, an attempt will be made to install machine rates. Since none of the machinery is especially costly and since it is all comparatively simple, they think it sufficient to charge 7½% of the depreciated value as the amount of depreciation each year.

39. THE PUBLISHERS' PRESS—ACCOUNTING FOR FOUNDRY WORK

All the departments of the Publishers' Press except the foundry, where plates of photographs and drawings were made, maintained an accurate system of cost accounting with complete details as to materials, labor, and overhead. To insure reliable costs in these departments, the management had installed an elaborate method of machine-rate distribution of overhead.

All plates formerly had been bought from an independent company on a square inch basis, and were charged into manufacturing costs at the actual prices paid. When the company began to manufacture its own plates, they were charged to jobs at the estimated amounts that the firm would have had to pay for them, and the foundry manufacturing account was credited with the same amount. The difference between the charges and credits to the manufacturing account of the foundry was closed out monthly to the general factory profit and loss account; no attention was paid to inventories of plates in process at the beginning or end of the month.

It was suggested that inventories should be taken at least at the beginning of each month, for which sufficiently accurate estimates could be made of all plates in process. Several members of the firm proposed dividing the actual expenses of the foundry for one month by the number of square inches of plates produced and using the resulting rate to charge plates made during the following month to their respective jobs; any difference

between the department's costs and credits would be closed monthly into the general factory profit and loss account.

In order to have the costs reflect the efficiency of the men working in the department, other officials desired to charge the cost of the material, labor, and overhead to each plate in each stage of its manufacture, since such a method would be more in accord with the cost accounting methods used in other departments of the company.

What system of costing the plates should the Publishers' Press have adopted?

40. THE DAILY SUN COMPANY—ACCOUNTING FOR NEWSPAPERS

The Daily Sun Company [1] uses from 17,000 to 20,000 tons of paper each year. It receives from two to three cars of newsprint each day, averaging about 25 tons to the car. The numbers which have been marked on each roll at the mill are checked in the pressroom with the invoices which also bear the roll numbers. Space for storing paper in terminal warehouses is rented from the railroad. In order to have the paper moved from the warehouses to the pressroom as needed, a yearly contract is entered into with a truckman who is notified each day as to the quantity of paper needed. Eleven full rolls, or 22 half-rolls, constitute a truck load.

At the warehouses it is planned to carry a reserve stock sufficient for three or four weeks. Since the printing plant is located in the high rent retail district, only enough paper is stored there to provide for an extra edition in case of any unusual happening. One pound of paper should produce 64 pages of newspaper, and complaint is made to the mill in case the paper is under- or over-

[1] The Daily Sun Company publishes a morning daily, a Sunday, and an evening daily newspaper. Both the morning and Sunday papers are conservative, but the evening paper is written in a more popular style. The former have a comparatively even circulation throughout the year, since subscribers have the paper mailed to them while they are on their vacations, but the latter paper suffers a severe decline in circulation during the summer months.

The Daily Sun places a yearly contract with a Connecticut mill for its newsprint, the price of which is established by agreement for the first quarter of the contract year, but for the remaining three-quarters is determined by the mill according to manufacturing costs. Because of the keen competition between newsprint mills, with the exception of a short period toward the close of the World War, the Daily Sun Company has not found that the present contract system has been disadvantageous. In 1922 the cost of newsprint received under this contract was from $70 to $80 a ton f. o. b. mill.

weight. Since full rolls can be used only in turning out an 8-page sheet, three-quarter rolls in turning out a 6-page sheet, and half-rolls in turning out a 4-page sheet, to produce an 18-page newspaper, a combination of a full, a three-quarter, and a half-roll is necessary.

Four classes of waste paper are recovered, and sold to a paper dealer. The first, which is known as white waste, consists principally of the butts of cores or the last sheets on each roll. Folded waste, consisting of spoiled inked newspaper, and a percentage of newspaper returns constitute the second class. The third class is wrapped waste, which is the wrapping paper enveloping the rolls as they come from the mill and which is removed at the pressroom. Floor waste includes everything not in the previous three classes.

Like that of most newspapers, the size of the Daily Sun publications depends principally on the amount of advertising secured. Since only a small percentage of the advertising comes in without being solicited, the advertising director has a soliciting force of 35 to 40 men, divided into local, national, foreign, and special sections. It is planned that the classified and retail store advertising will yield very little more than the cost of the space used, because these advertisers will probably derive little benefit from the circulation of the paper outside their immediate locality. The basic line rate for these classes is determined, therefore, by dividing the total expense for this section of the newspaper for any given month by the number of lines of advertising carried. An extra charge is made for advertisements calling for insertion on the first, last, editorial, second, or third pages, varying in amount in the order given, but when advertisements which might be put on any page are placed on these pages merely to fill the page, the basic line rate alone is charged. Large advertisers are given no rates more advantageous than those given the user of less space. Two copies of the formal advertisement order are made out. One goes to the composing room where the work is set up; the other is for the use of the bookkeeping department, which checks it with the advertisement appearing in the paper and makes the charge to the customer. About 95% of the classified and 99% of the other advertising are on charge accounts.

The use of numerous pictures in the modern newspaper has

caused the Daily Sun to develop its own photo-engraving department. First, a negative, wet-glass plate of a photograph or drawing to be reproduced is made in the required size, and then the film is removed by a chemical process from the glass. A chemical reaction transfers the image on the film to a flat metal plate, and another hollows out those portions of the surface which are not to bring ink in contact with the surface of the paper. A routing machine, operated by hand, deepens the hollows where necessary to make bolder impressions. The finished plate is now ready to be locked with other type into the page forms. Four-color work differs only in that four plates must be made for it, one for each color. The paper must be brought in contact with each of the four in succession before it receives the complete impression.

It is planned to produce about 90 columns of news in the daily newspapers, or the equivalent of about 11 full pages each day. It is newspaper practice to print in full all speeches of the President of the United States, but only when a speech of considerable length is made is there any difficulty in restricting the news columns to 90. The process of printing the news sections begins with the collection of the news items by the reporters, who hand them in typewritten form to the editor. If the latter thinks that they are of sufficient interest to be printed, they are given to "rewrite men" to be cast into proper form. From the rewrite men the news items are taken by Lamson pneumatic carriers to the foreman of the linotype department, who distributes the work among the operators to be set up in type. These linotype machines, which are operated by a key-board, much the same as that on a typewriter, cast the type in column width one line at a time. A monotype machine which casts separate characters is generally used to cast the type for the larger headings. The headings and the linotype leads, together with the picture cuts, are then set in a frame which is the exact size of a page. Samples are printed from the type and given to half a dozen proofreaders for correction.

When the frame has been filled and locked, it is covered by a cardboard mat which is brought firmly against the face of the type in a press, so that an impression of the type is made on the face of the cardboard. The mats are then taken to the lower floor where they are put into semicircular machines where a lead

casting is made in such a way that when it hardens a hollow semicylindrical page-size form of type is obtained ready for the press. Two of these forms are attached together to form a hollow cylinder, one-half of which prints as the other half is being inked. The paper passes in one large sheet through the press rolls, and is then cut and folded automatically into a complete newspaper. A mechanical contrivance causes each fiftieth paper to be turned conspicuously. Belt conveyors carry the completed papers to a delivery room, whence they are sent out to the consuming public.

A detailed production accounting system is unnecessary. Definite rules are promulgated in the union agreements that compel the use of an exactly determined number of men for whatever number of pages are to be printed. Printing machinery, too, is so standardized that there is little leeway for chance in the consumption of ink and paper. Production costs are absolutely dependent upon the number of pages printed and the extent of circulation, and may thus be predetermined. Monthly receipts and expenditures are compared, however, and comparisons are also made with figures from preceding years. With the exception of officials, all the labor employed in the plant is unionized and paid by the day. The unions are responsible for the punctuality and attendance of the men at their work.

41. JONES CARD GAME COMPANY—STANDARD COSTS

The purchasing department of the Jones Card Game Company set standard costs by which the cost accounting department charged raw material to the different departments. These standard costs were based upon what the purchasing department expected to pay. When a purchase was made, for example, the stores department was charged with the standard cost of the material. Materials were requisitioned by the producing departments and charged out of the stores department at standard cost. The difference between the standard and the actual costs was charged or credited to a single price variation account at the time the material was purchased. Whatever balance was in this account at the end of each month was charged or credited to the factory profit and loss account, which, at the end of the year, was closed out to the general profit and loss account. In

the storeroom a card record, gummed on one end, was attached to the raw material to designate what it was. The part not gummed was detached and sent to the purchasing department for its records which included cards showing the quantity of each material received, the quantity issued on requisitions, and the balance on hand. The gummed tag was the only record kept in the storeroom. On everything purchased in large quantities the accounting department added the unit costs of freight. On small items purchased in small quantities, the accounting department charged the freight to the purchasing department expense account, which also was charged with the purchasing department costs for clerical work, receiving expense, and handling expense. The ratio of expenses to total purchases gave the overhead percentage for the purchasing department, which was about 2½%.

When raw materials were required in a producing department, the foreman or clerk in the department issued in triplicate a requisition on the stores department; one copy was sent to the storeroom, the second retained by himself, and the third sent to the producing department with the stock. The original went through the storeroom to the purchasing department, whence, after the proper entry had been made on the card record, it was sent to the accounting department where requisitions were collated and grouped by items, in order that in charging the producing departments at the end of each month, quantities need be multiplied by the standard costs but once. There were several raw material accounts corresponding to the different divisions of the factory; the requisitions showed the department of the factory which was to be charged. The purchasing department was charged with the purchases and expenses and credited with goods requisitioned plus a percentage for the overhead and the amount of the freight. The producing departments were charged with the standard purchase price and stores cost. Special stock required for special orders was charged directly to the department or to the order at the actual cost including freight plus 3% for handling. The regular stores accounts were for ordinary materials only. The total materials used always could be ascertained, because ledger accounts showing the direct purchases were kept. Cardboard stock was the principal raw material entering into the manufacture of playing cards.

In the manufacture of playing cards the stock was first run through a color machine, colors for which were mixed in a machine according to formula, which was used for cost figuring purposes, and counted among their principal ingredients water, cutch, clay, and pulp colors. A standard amount of color was used, and the actual cost per gallon for each color, which varied considerably in price, was obtained. The cost accounting department ascertained the number of reams colored and the amount of color required. A clerk then multiplied the number of gallons of each color by the cost per gallon, and divided the total for all colors by the total number of gallons, obtaining an average cost for all colors except white. A separate cost for white was obtained because it was cheaper. From these records of the reams colored and the gallons of color, it was possible to ascertain the quantity of color required per ream. The number of gallons multiplied by the gallon cost indicated the cost of color per ream of paper. Records were kept of the number of reams colored and the time taken. It frequently was necessary for stock which was to be colored white to be run through the machine a second time; separate records, therefore, were kept for white. From the number of reams colored and the time taken, it was possible to find the average number of reams colored within an hour. In order to figure the hour rate for the coloring machines, a record was kept of the hours the machines were running. The distribution of the payroll showed the total cost of labor for machine coloring and also for color mixing. By taking the average monthly payroll for the color mixers and adding the average monthly payroll for the color machine operators, plus the standard percentage of both for the overhead, and dividing the total by the machine hours during the period for which the payroll was taken, a standard hour rate was obtained. From the average number of reams colored per hour and the machine-hour rate the average cost per ream for color was obtained.

In the next process the color was fixed so that it would not run. The cost per ream of material, the labor cost, and the overhead were obtained in the same way as in the color process. The principal materials used in fixing colors were alum, water, oil, and casein.

The next process was calendering, or polishing, which gave a

glossy smooth finish to the paper. A record was kept of the number of reams run through the process and the time taken in order to give the average number of reams per hour, and also of the time of the machines and the amount of the labor payroll. The overhead was added to the payroll, and the total divided by the machine-hours to find the machine-hour rate, which, taken in connection with the reams per hour, denoted the average cost per ream for calendering.

In another department the large rolls of stock were slit into narrow rolls. Some of the stock which was used in large quantities was cut into narrower rolls of exactly the right width for special orders, and the balance cut into standard sizes to be kept on hand and recut later as needed. Then, for example, if an order for a 1½-inch width was received, it was cut from these standard widths on smaller slitting machines. Accordingly some stock was slit and reslit several times. Naturally that part of the stock which was reslit most often had a comparatively higher slitting cost. The cost of slitting varied from 24 cents to $2 per ream, according to the amount of reslitting necessary.

The expense of the truckmen who moved the rolls and the men who helped the slitting machine operators was included in the slitting-machine hour rate, and not in the department overhead. The payrolls of the operators of the big slitting machines and the smaller slitting machines were kept separate. The total of the wages of the operators of the large slitting machines, the wages of the operators of the reslitting machines, the wages of the truckmen and helpers, and the overhead divided by the number of machine-hours of the large slitters indicated the hour rate for slitting. Since slitting was a fast operation, there was no essential inaccuracy in applying this hour rate to the different classes of material.

Stock was purchased in a large number of qualities and in different widths varying from 68 inches to 20 inches. A different standard cost for slitting had been worked out for each class of stock based on the amount of reslitting necessary. The number of sheets in a roll and the time taken to slit was reported for purposes of working out these standards. A length of 28 inches in the running roll was regarded as a sheet length. A coefficient had been worked out for each width to reduce the width to a 22½-inch base in order to compute the number of standard

sheets 22½ inches wide by 28 inches long in each roll. Every roll was reduced to standard sheets by multiplying the total sheets by the proper coefficient for the actual width, the coefficient being the proportion of the actual to the standard size of 22½ inches in width. The total time taken for all slitting was ascertained; the total time taken on the total number of sheets 22½ inches by 28 inches was known and the average time per ream for the standard sheets for slitting could be ascertained. When any reslitting was done, the time taken was entered but not the quantity slit; therefore the more reslitting there was, the greater was the time required and, consequently, the less the average quantity per hour slit. The machine-hour rate was divided by the average quantity per hour for each class to derive the average cost per ream for slitting, which covered both the original slitting and the reslitting.

Several unit costs for stock were used, according to the manner in which the material was used. Theoretically, there were 150 pounds to each ream, 500 sheets of the standard size of 22½ inches wide by 28 inches long, of the stock referred to in the illustration. The stock was tested in the laboratory for weight, and if there was a serious variation in standard, complaint was made to the mill. To figure costs average weights were used. The total cost per ream for the paper, coloring and fixing materials, and processing was obtained, and an allowance added for waste, principally on ends and edges. The unit costs were figured in several ways for the use of the clerks. An example of the method by which the computation was obtained is given on page 558.

The cost per 100 sheets was figured both in strips and sheets. Then the cost per pound in large rolls and in strips and the cost per thousand square inches were ascertained. The waste allowance for strips was 5%, for sheets 2%. After the cost of the stock, color, fixing materials, and processing and an additional 5% for waste were added together, the sum, which was the total cost for strips, was added to the slitting cost which in this case was 60 cents. This total, which in the illustration was $17.14, was divided by five in order to derive the cost per hundred sheets in strips, $3.43. In obtaining the cost per hundred sheets in sheets, only 2% allowance was made for waste; adding 2% of $15.75 or 32 cents to the $15.75 gave a total per ream

No. 150 (This indicates the theoretical 150 pounds to a ream 22½ inches by 28 inches).
153 (This indicates the average weight per roll).

Item		Cost
153	at 8 cents	$12.24
Color		1.55
Alum		.05
Coating (Labor)		1.05
Fixing (Labor)		.45
Polish (Labor)		.41
		$15.75
5% waste		.79
Total for strips		$16.54
Total for sheets (2% for sheet waste)		$16.07

In strips, per 100—$16.54 plus .60 gives $17.14, divided by 5 gives $3.43.
In sheets, per 100—$16.07 plus $1.50 gives $17.57, divided by 5 gives $3.51.
In large rolls, per pound—$15.75 divided by 163 gives .096.
In strips, per pound—$17.14 divided by 163 gives .105.
Per 1,000 square inches—$17.14 divided by 315 gives .054.

of $16.07, to which was added the cost of slitting, $1.50, giving a total ream cost of $17.57, which was divided by five to obtain the cost of a hundred sheets; namely, $3.51. Next the cost per pound in large rolls was secured by dividing by the number of pounds per ream. In the illustration given the weight per ream had been increased on account of the weight added through the color, in which clay was the principal ingredient, from 153 pounds to 163 pounds; therefore, $15.75 divided by 163 pounds gave a resultant cost of 9.66 cents in large rolls. To derive the cost per pound in strip, the strip cost, $17.14, divided by the weight, in this case 163 pounds, gives 10.5 cents, which was greater than the cost per pound in large rolls, 9.06 cents, because of the percentage added for waste and the cost for slitting. Finally the cost per thousand square inches was computed. The strip cost per ream, $17.14, divided by 315[1] gave 5.04 cents. The number of square inches in a card was found easily from a chart which was capable of taking a card up to 8 inches by

[1] A ream = 500 × 22½ × 28 = 315,000 square inches.

20 inches, practically the entire range of flat work. If the cost clerk, therefore, had an order for 10,000 cards, he multiplied the square inches in the card by the cost per thousand square inches and multiplied this result by 10. Practically all the card work was run from strip stock.

The divisional office kept in detail the accounts of direct and indirect labor, of which the totals were sent monthly to the factory ledger bookkeeping department. Vouchers for interdepartmental charges were forwarded monthly by the divisions affected to the same department. From the charges and credits in the factory ledger, the bookkeeping department made up monthly statements for each department. An illustration of the accounting control sheet for a division for one month in the year 1921 follows:

Account	
Expense Account	
Indirect Labor	$68
Vacation (monthly average)	6
Spoiled work	1
Repairs	115
Shrinkage	17
Expense supplies	3
Stationery	3
Gummed paper	25
Miscellaneous Supplies	...
Sub Total	$238
Service charges	360
Total Expense	$598
Overhead Credit	727
Overhead Loss	....
Overhead Gain	$129
Operating Account, Debit	
Overhead brought down	$727
Coloring direct labor	363
Polishing direct labor	73
Plating direct labor	3
Roll pasting direct labor	84
Miscellaneous direct labor	120
Total Debits	$1,370
Operating Account, Credit	
Overhead credit	$743
Coloring direct labor	319
Polishing direct labor	76
Plating direct labor	121
Roll pasting direct labor	99
Miscellaneous	162
Total Credits	$1,420
Operating Loss	...
Operating Gain	$50
Stores Account	
Material charges	$ 841
Material credits	1,341
Increase in Balance	...
Decrease in Balance	$500
Inventory, Jan. 1	...
In Process, Dec. 31, 1921	...
Profit and Loss Account	
Overhead Loss	
Operating Loss	
Overtime Loss	$65
Cost Account Loss	
Shrinkage of Inventory	50
Total Loss	$115
Operating Gain	$ 50
Overhead Gain	129
Total Gain	$179
Net Known Loss	...
Net Known Gain	$64

In this illustration the total overhead expense was given as $598, whereas the overhead credit given the department, the standard overhead percentage of the direct payroll, amounted

to $727, resulting in a gain to the department of the difference between the two, $129. In the operating account on the debit side the overhead was brought down as $727 rather than $598, because it was desired to add the standard overhead charges to the direct labor to obtain the total charge to jobs for labor and overhead. On the credit side of the operating account the overhead credited was $743 which did not agree with $727 because the identical goods charged to this account during one month might not have passed out entirely within the course of the month, and also actual direct labor might have been more or less than the direct labor credited to the department on account of the difference between the actual and standard costs. The excess of $50, merely means that the credits to the account during the month exceeded the debits by $50. In the stores account the materials were charged at actual costs and credited at standard costs. The small debit as compared with the large credit might be due to decreased prices actually paid for the goods, while the standard costs figured on the higher purchase price were used for the credits; or the actual amount in process might have been reduced. It was the practice of the company to regard a reduction of the balance as a decrease in the quantity in process until the physical inventory had been taken, which might show a gain or loss as compared with the book figures. Such a gain or loss was closed into the factory profit and loss account. The figures for overtime and the shrinkage of inventory came from subordinate records not mentioned in this paper.

The next step in the making of playing cards was the setting of the type and the making of the electros for printing. Tests were made to find out the length of time it took to set up various classes of work, either by hand, or by linotype. As in the other departments, there was an hour rate for the composing room. The principal classes of labor included the compositors who set the type, the distributers who put the type back in the cases, the stoneman who hammered the type flat and ran off a proof on hand presses, the layout men who made certain that the work was in proper form, and the correctors who corrected mistakes after the proof had been read by the proofreaders. In figuring the costs in this department, the time of the compositors only was taken and the wages paid to all the men in the department. The overhead was added to the total payroll which was divided

by the compositors' time. Standard rates for crediting the jobs to the departments were ascertained by tests. These standards were used for the average sort of work set up. All special and unusual set-up jobs not covered by the regular standard rates were charged for the actual time at the standard hour rate. The company used some linotype machines. In figuring an hour rate for them the total payroll of all the help in the department plus the overhead was added to the price of the lead used, and divided by the time a machine was in operation. Then from tests the required standard rates were found which were used in charging out work. Again, in this case, special work which comprised difficult classes not covered by standards, was charged out at the standard hour rate for the actual time taken. After the linotype work of molding the slugs, the compositors set up these slugs in form for printing. Standard rates for make-up or the setting up of the slugs by the compositors were made from tests and time studies. The purpose of the standard rates, which were supposed to be an average of the costs of the various jobs, was to make the charges uniform.

Both the original type and linotype slugs were used on the presses for short jobs, but it was necessary to make electros for long jobs. For electros the process costs on the square inch basis were obtained. Sheets of wax of uniform size were used to take impressions of originals, which, since they varied in size, might be used singly or in groups. After certain preliminary preparations the wax impression was covered with graphite and put into the electrotype bath where copper collected on it. Then the copper plate was separated from the wax and washed, and molten lead was poured on the back of it to give it body. The two metals were fused together by means of a tin foil. Finally the electros were sawed out, trimmed, tacked on wood, and prepared for use in the press. A record was kept of the number of square inches of electros made in a period of time. By adding the materials cost to the cost of the direct labor and the overhead, which was a percentage of the direct labor payroll, the total cost of the electros was found. By dividing the total cost by the total square inches made, the average square inch cost was obtained readily. The cost of electros was charged to the job by means of a chart showing the number of square inches comprised in an electro. The charge to the job and the credit

to the department for the electros were made in the factory ledger accounting department.

There was a separate work order sheet for each department performing work on an order. When the printing department had figured the cost of the electros and composition, the costs were entered on that department's copy of the work order sheet. All work orders were numbered. The numbers ran up to 100,000 and then repeated. In the department the costs also were put on collation sheets according to the work order prefix letters which corresponded to the divisions of the holding files. When the work was finished and the work order sheet completed, the cost was entered on the collation sheet and the work order sheet was stamped "credited" and sent to the office of the factory ledger accounting department where it was put in the holding file. At the end of the month these collation sheets were sent to the factory ledger accounting department. There was an account for every division of the holding file. B orders, for example, were for one class of work and L orders for another class. These accounts on the factory ledgers were called holding accounts. On the collation sheets the cost of compositions and electros were kept in separate columns, under the work order prefix letter. Then, at the end of the month, the column was totaled before the sheets were sent to the factory ledger accounting department, where the totals were charged to the proper holding accounts, and credit was given the proper producing department accounts. The holding department accounts were supposed to agree with the total of the work order sheets in the holding file for which the total was the controlling account. When articles were finally shipped out to the distributing stations, the holding department was credited, the distributing stations debited, and the work order sheets in the holding file transferred to the dead file.

Ink was carried in a separate department. Each job was charged for any special mixed ink that had to be made for it, whether or not it was all used. In case this procedure seemed unfair, however, the error account of the department could be charged. When the work order sheets were made by the planning department for any job, the work order sheet was made out for inks to be specially mixed, and sent to the printing department, where the number of pounds of ink to be mixed was

estimated. The work order sheet was delivered to the ink department in time for the ink to be mixed in order to have it ready when it was needed in the printing department. This procedure was used for all mixed inks and also for exceptionally large quantities of regular inks. The printing department had a supply of ordinary inks on hand with which it filled the fountains in the press for all orders not requiring specially mixed inks, or exceptionally large quantities of regular inks. This ink was charged to the material account of the producing department, when it was drawn from the storeroom, along with other materials such as cleaning rags and benzine. They were charged to the job at standard rates according to the article made. In the case of large orders a charge was made to the order instead of the producing department, and credit was given to the department storing and mixing the inks when the ink was drawn.

Eyelets used in the manufacture of these cards were drawn from the raw materials stores and charged to the producing department material accounts. The numberhead, which was a small machine that fitted the press, was used in numbering certain cardboard portions of the game. Die men took care of the perforating machines and numberhead men were in charge of the numberheads. One operation printed both sides of the card, numbered and cut the corners. Since in the printing department the machines were similar there was only one hour rate, which was obtained by adding the direct labor payroll, the general direct labor payroll, which included die men and numberhead men, and the percentage for overhead, and dividing by the number of machine operators.

The work was divided into various classes according to the sort of work printed. Direct and indirect labor was charged from the Hollerith tickets to labor accounts in the ledgers. One card was made for the make-ready and one for the run. The total production for each code number, each class of work, and the time taken was found. In order to obtain the average hourly production for checking with a standard, totals for 12 months were used to give effect to the variations within the yearly period. The average make-ready time and the average hourly production for each class of work were obtained. By dividing the hour rate by the standard average production, the cost per

thousand for printing was derived. On make-readies the standard time per make-ready was multiplied by the hour rate.

Records were kept and standards set for one- and two-side printing work. The stone work, which was preliminary to the make-ready, consisted of taking electros and type, locking them in the chase, and spacing them. A standard cost obtained from records and tests was applied to each job. The total stone cost and the number of jobs done were known. Since the work did not vary much, it was possible to obtain the standard by dividing the cost by the number of jobs. From these figures rates were made to facilitate pricing and for use in the estimating and selling departments. The cost clerks had the cost for each class of work, according to the kind of printing, made up as follows:

	5,000	10,000	15,000	20,000
Make-ready cost	$0.95	$0.95	$0.95	$0.95
Stone cost	.10	.10	.10	.10
Running cost	.61	1.21	1.82	2.43
Total	$1.66	$2.26	$2.87	$3.48

When the printing machines were in operation, it was necessary to watch the feed of the ink and to make certain that the machines were operating correctly. When it was impossible for one man to pick up the cards and to put them in boxes, a girl was employed to take them off the belt and box them, for which, of course, there was an additional charge. The pay rate of the girl plus a percentage for overhead was added to the running rate. When the jobs were completed, the cost clerks in the department used the figures given in the above table to give credit to the department. They endorsed it on the work order sheet, stamped the sheet "credited," made an entry on the collation sheet, and forwarded the work order sheet to the office at once by way of the planning department. The cost clerk in the department credited the material account for all material used and charged the order. At the end of the month the holding account was charged from the collation sheet and the producing department credited.

The product was put into boxes which were charged at standard rates to the producing department box account by the department making the boxes. A standard percentage was al-

lowed each department for waste, because when the cost of stock was figured, the amount covered only the actual stock to be used.

A check was kept on the work the employees were turning out. If the machines were not running smoothly the employees complained to the foreman who then ascertained the trouble. All work also was subject to inspection. In order to keep a check on the waste allowance rate, a slip was attached to each order showing the standard allowance for waste on that particular job. When the job was completed, the waste was weighed by computing scales and the actual quantities of work wasted determined. At the end of each month the actual and standard quantities of waste for each class of work were compared and the gain and loss on waste computed.

All stock for boxes used to hold the games came in bundles of sheets. All news board and strawboard came 50 pounds to a bundle. The raw material cost was figured by the ton, but, since there might be any number of pieces in a bundle, the cost per bundle had to be figured. According to a standard classification used, Number 50 board has 50 sheets to the bundle, and Number 60 board, 60 sheets to a bundle. After the cost per bundle was found, the cost per 100 sheets was figured. In figuring the cost of the boxes, the pieces of board for each box had to be taken into account, one for the top, one for the bottom, and two for the ends. The number of sheets of board necessary to make 1,000 boxes was determined, and, as in the case of the stock itself, an allowance had to be made for waste.

Operations in box making were (1) guillotine cutting, in which a pack of cards was cut at once; (2) scoring, which consisted of making grooves in order that the boards would bend easily; (3) double power corner cutting, whereby two corners of a box were cut at one time; (4) partial folding of the top and bottom and (5) ending, which consisted of putting in the ends. All the above work was done by machines. Girls did the staying, which consisted of pasting on corner stays, and stripping, consisting of pasting strips around the top and bottom and rubbing the strips down. The rubbing down was done by hand, but the staying and stripping was done by machine. Sometimes staying and stripping were combined as one operation. Loss and gain were figured in this department, the actual time taken being compared with the standard time allotted. The quantity pro-

duced, the time taken, and the average production were used in connection with the standard labor-hour rates to obtain the various costs of the different operations per unit.

The operations of stripping and rubbing down were paid for on a task-and-bonus system, determined by time studies carried on by the time-setting department. From the time studies for each operation on boxes of given size, the standard time for 100 boxes was figured. The girls were paid a base rate and a piece-work rate. The base rate was a fixed amount per hour based on the efficiency and the length of service of the girl, and the kind of work she was doing. The other rate was an hourly rate divided into three classes: (a) (b) (c), according to the difficulty, and the skill required. For each class an hourly rate was set for the entire factory, class (a) being the highest paid.

For illustration, assume a job where the standard time was 10 hours. This job, of course, might be done in 8, 10, or 12 hours. On the assumption of a base rate of 25 cents an hour, and a class (b) job at 16 cents an hour for the piece-work rate, the following table illustrates the cost of the work:

Example 1

10 hours standard time at piece-work rate $0.16 =	$1.60
(Done in 8 hours) 8 hours actual time at base rate $0.25 =	2.00
2 hours saved (goes to girl) time at base rate $0.25 =	.50
Total	$4.10

Example 2

10 hours standard at $0.16 =	$1.60
(Done in 10 hours) 10 hours actual at $0.25 =	2.50
Total	$4.10

Example 3

10 hours standard at $0.16 =	$1.60
(Done in 12 hours) 12 hours base at $0.25 =	3.00
Total	$4.60

When a job was finished in 12 hours, it cost the company more money than in the other cases. The girl was working in this last case at a rate slightly in excess of 38 cents an hour, whereas in the first case she received 51 cents an hour, and in the second

case 41 cents. The efficiency in each of the three cases was, therefore, 125, 100, and 83 1-3%, respectively.

In this department record was kept in a suitable classification of the standard and actual times of the various operations, and the amount of the money actually paid to labor for operations. The work was divided not only into the (a) (b) (c) scale classifications, but also according to staying, stripping, and rubbing down operations. The overhead was added to the payroll in figuring the standard-time hour rate, which was used in connection with the standard time of the operations. Suppose the job illustrated amounted to 10,000 units and the standard time set was 500 an hour for stripping. If the standard-time hour rate was 75 cents an hour, the cost for stripping 1,000 would be two standard hours at 75 cents, or $1.50. If the job for which the standard time was set was performed and paid for on the basis of the actual time taken, the standard time also was recorded, so that the standard-time hour would be based on all work supposed to be done at standard time. The management believed that this was the easier and the more accurate way to handle this sort of work where there were thousands of operations. The box department was credited monthly, and the department to which boxes were sent was charged in the factory ledger accounting department from the collation sheets. Work order sheets ordinarily were not used in this department. The printing department sent a schedule of its requirements to the box department, and the entries on the factory ledgers were made from vouchers for actual quantities delivered.

The cards were sent to a special department where the numbers printed on them were inspected. These inspection operations were classified; records were kept of the production; the time taken and the average hourly production were found, from which the standard costs were figured for the various classes of work. The collation sheet from this department was received monthly by the factory ledger accounting department, and from it a credit to the department and a charge to the holding account were made.

In this plant standard overhead percentages were figured for each department or production center. These were based on normal conditions over a period of at least three years, so that

the costs would represent the manufacturing expenses incurred at times when the factory was operating under usual conditions. During the period of prosperity which ended in 1920 the overabsorption of burden was approximately equal to the amount of underabsorption incurred in the following depression.

42. LANE BOTTLE COMPANY—DIVISION OF PROCESS COSTS

The Lane Bottle Company was about to install a bottle-frosting department, and wished to devise a proper cost accounting procedure. In the frosting of bottles the principal operations were: (1) wiping off dust by hand with a cloth; (2) placing each bottle on a board about 4 feet long by 2 feet wide provided with conical pegs, which fitted into the mouth of the bottles and held them firm when the peg board was inverted in the chemical solution, where the actual frosting operation took place; (3) inverting the peg board in a chemical solution where it was kept from two to five minutes, according to the hardness of the glass in the bottles; (4) placing peg boards in an upright position out of the solution and allowing them to drain; (5) transferring the bottles by hand individually from the peg board to the pegs on a circular traveling machine which washes the bottles inside and outside; and (6) removing the bottles by hand from the washing machine pegs and placing them in cases.

Since much of the work consisted in handling bottles individually, in which size of the bottle was of no importance, it was suggested that the cost of frosting be obtained on a bottle basis. It was pointed out, however, that since the larger bottles required more frosting chemicals in the solution, some attention would have to be paid to size. During a typical month, labor and overhead costs for frosting in the factory of a competitor of about the same size as the Lane Bottle Company amounted to more than twice the material costs.

Several officials of the Lane Bottle Company believed that it was best to cost frosting on a square inch basis. Since stoppers, however, were made for the specific bottles with which they were to be used and were attached by strings to their respective bottles throughout the frosting process, the difficulty of handling them in the chemical solution depended not on their size, but rather on their number.

Lane Bottle Company—Cost of Frosting Bottles

Three Months Ending March 31.

Bottle Number	Production Quantity	Material				Labor and Overhead				Total			
		Points per Each	Equiv. of Prod. Points	Cost of Prod.	Cost per Hundred	Points per Each	Equiv. of Prod. Points	Cost of Prod.	Cost per Hundred	Cost of Prod.	Cost per Hundred	Cost of Finished Product per C	
												Plain	Frosted
872	12	22	264	$ 0.8145	$6.7875	13	156	$ 0.0646	$0.5383	$ 0.8791	$7.3258		
892	3862	13	50,206	154.8940	4.0107	9	34,758	237.2060	6.1421	392.10	10.1528		
916	106	6	636	1.9622	1.8511	13	1,378	9.4042	8.8719	11.3664	10.7230		
915	100	4	400	1.2341	1.2341	10	1,000	6.8245	6.8245	8.0586	8.0586		
911	5039	4	20,156	62.1847	1.2341	7	35,273	240.7206	4.7771	302.9053	6.0112		
912	108	6	648	1.9992	1.8511	9	972	6.6334	6.1420	8.6326	7.9931		
Totals			72,310	$223.09			73,537	$500.85		$723.94			

Analysis of Charges to Frosting Room

Item	Amount		Points Produced	Cost per Point
Material	$223	09	72,310	$0.00308517
Material Loss Labor Overhead	500	85	73,537	.0068245
Totals	$723	94		

Form 44: Lane Bottle Company—Cost Form

The Kingston Company, one of the Lane Bottle Company's largest competitors, compiled its cost on sheets similar to Form 44. In the first column the numbers of the bottles, based on size, were inserted. The next column showed the quantity of each size of bottle made during a production period. Column 3 indicated the number of cost points for the various sizes of bottles which were determined by tests that ascertained the quantity of materials used on each size of bottle; the quantity, of course, was dependent largely on the size, the large bottles having a proportionately larger number of cost points. The points per bottle of each size multiplied by the quantity gave the figures in column 4. As shown under "Analysis of Charges to Frosting Room," the lower table, in Form 44, the total charge for materials was divided by the total of column 4 to find the cost per point. The cost per point multiplied by the number of points of each size indicated the cost of frosting each size of product. In column 6 the cost for 100 bottles of each size was shown. Labor and overhead charges were added together and handled in the same way as charges for material, except that the cost points for labor were determined by tests which showed the amount of labor required for bottles of each size. The overhead was added to the labor charges, because it was believed that it should be distributed on the basis of the direct labor payroll, which consisted normally of one man at 42 cents an hour and two women at 25 cents an hour each.

Which procedure for costing the various sizes of bottles in the frosting process should have been adopted by the Lane Bottle Company?

43. CLINTON ELECTRIC COMPANY—DETERMINATION OF MARKETING COSTS BY COMMODITY GROUPS

The Clinton Electric Company desired to know its marketing costs by commodities in order that it might fix prices more intelligently, add and eliminate lines, and make special sales efforts. Two-thirds of the total orders received by the company were for $10 or less. The volume of all these small orders amounted to 12% of the total volume of sales. Eighty per cent of the sales had been to 300 customers, the remaining 20% to 3,700 customers. It was believed that small orders were partially responsible

for a high expense ratio. About 40% of the sales were direct shipments from factories, so that the expense of handling commodities was likely to vary. Because of the many factors entering into cost, it was decided that an attempt should be made to segregate all costs by lines of commodities. The Electrical Supplies Jobbers' Association became interested in this problem, and as a result five electrical jobbing houses attempted the study during 1921. A report was made which included the following information:

This report covers the total operating expenses under the Uniform Accounting System and has no reference to the profit or loss on the sale of any commodity. These expenses are classified in four general groups, namely: Administrative, Financial and Accounting, Selling, and Warehousing.

The first supervises all the work; while the other three are functioning departments.

The following is an explanation of certain terms used throughout the report as applying to expenses:

Department: A major division of expense, namely: Administrative, Financial and Accounting, Selling, Warehousing

Subdepartment: An actual branch of one of the major departments or specific operation thereof

Bill: Charge rendered to customer

Invoice: Charge received from a manufacturer

Item: Each separate entry for material on a bill, credit memorandum or invoice, irrespective of the quantity of material in that entry

Unit: A measure fixed for the proper distribution of cost of physically handling material

The commodity classification, with the necessary description of each commodity, is shown on pages 578 and 579.

Included in this classification is one designated "miscellaneous."

This list of commodities was flexible for the different houses, so if in one house the sales of a certain commodity did not warrant a separate classification, it could be eliminated; also when a house sold a sufficient amount of a commodity, not shown in the classification, a separate classification was added. There was a strict rule that in no instance could the miscellaneous classification include sales of more than 10% of the total sales of the house. In practice for the year 1921 this classification amounted to only 2.5% of the total sales.

On the report, we have grouped some of the commodities because either there were no sales in a majority of the houses or the total sales of all houses were not sufficient to make a separate percentage valuable. These groupings are numbers 36-37-38-39 in the report and the commodities included will be explained later.

The first operation of the study was to obtain a physical inventory by commodities at the beginning of the period, also one at the ending of the period, and of the book value at the end of each month.

The sales and expenses of a non-jobbing department such as retail, repair, manufacturing, or construction, which might include numerous commodities, are eliminated from the regular commodity classification and distributed under one heading. Such departmental classifications in this report, are included in number 39, Sundry Commodities.

The total net sales must be classified by commodities; also by warehouse and direct. Therefore, the total sales and expenses according to commodities and for non-jobbing departments agree with the actual sales and expenses entered on the books. Purchases are classified by stock and direct. The number of bills and credit memoranda issued, as well as the items thereon, was obtained, and it was necessary for us to ascertain the number and weight of packages shipped, segregated by original packages and warehouse packages; also the number of items shipped; the number of items on purchase orders and the number of items on invoices and credit memoranda received from manufacturers; the number of units and items on receiving reports and the weight of material received.

In order to allocate some of the expenses we obtained the square feet of space occupied or reserved in the warehouse for each commodity; also the space used by each general office department or subdepartment.

Because the administrative expenses were allocated or assessed to the different functioning departments we were obliged to ascertain the total administrative expense by adding to the direct expense of that department their proper proportion of the rent, stenographic service, stationery, telephoning and telegraphing, postage, taxes, insurance and depreciation. Therefore, when we consider the salaries and expense of the department or individual, this includes the proper proportion of the above expenses.

ADMINISTRATIVE EXPENSES: These expenses are distributed as follows:

Salaries and Expenses of Executives: This expense is charged to the three functioning departments according to the time spent in supervising them.

Other Administrative Salaries: Salaries and expense of other employees charged to administration, such as office boys, central filing clerks, mail clerks, and so forth, are charged to the functioning departments and subdepartments in accordance with duties performed, after the proper portion had been charged to the administrative department.

Postage: This is the expense of all postage, except that which is used in sending out advertising matter, and is allocated to the different departments or subdepartments by actual count. As an example, the

postage used in mailing bills or statements was charged to billing and accounts receivable.

Stationery and Office Supplies: This expense is distributed by two different methods. Stationery which would include printed forms, is charged to the departments or subdepartments utilizing them, according to the quantity used, while office supplies, such as pencils, pens, penholders, and so forth, are charged to departments or subdepartments, on the basis of number of employees using them.

Taxes: This expense is first divided between the general office and warehouse on either the space occupied or the value of stock carried, or the accounts receivable outstanding, depending on the nature of the tax, and is then divided to commodities, departments or subdepartments on the value of the equipment used by the departments or the value of the commodity carried, or the sales billed when applied to accounts receivable.

There is no Federal income or excess profits tax included in the expenses, as those taxes are considered a direct charge to profit and loss, rather than an operating expense.

Telephoning and Telegraphing: We prorate the regular monthly charge for telephones, including the salaries and expense of telephone operators, to the departments and subdepartments using the telephones. The toll charges and telegraphing expense are charged direct to the commodity where possible; otherwise to the department or subdepartment creating the expense.

Rent: This expense for the general office is prorated to departments and subdepartments, according to the space occupied.

Insurance: This expense is prorated to departments and subdepartments, based on value of equipment used. It does not include insurance on merchandise, which will be explained later.

Depreciation on Fixed Assets: This expense is first divided between general office and warehouse, in accordance with the value of equipment used, charging the general office division to departments and subdepartments on the value of the equipment, and that portion charged to the warehouse to commodities on the basis of space occupied.

Donations and Contributions: This expense is charged to the departments and subdepartments on the same basis as executive salaries are distributed.

Trade and Association Dues: After allocating to special departments and subdepartments any expenditures that could be so assigned the balance is charged on the same basis as executive salaries.

Light, Heat and Power: We have divided this expense between the general office and warehouse, in accordance with current consumed and radiation. The general office portion is charged to departments

and subdepartments by the same method, and the warehouse portion to commodities on the basis of space occupied.

Maintenance of Building: This expense is prorated to commodities, departments, and subdepartments, on the basis of space occupied.

Unclassified Administrative Expense: Where possible this expense is allocated to departments, subdepartments, or commodities. The balance is assessed to the different departments on the same basis as executive salaries.

FINANCIAL AND ACCOUNTING: The average total expense of this department for all houses for the period in review was 3.21% of sales. This includes not only the actual expenses of the department, such as salaries, but also this department's percentage of rent, postage, insurance, stationery, and its proportion of administrative expense.

The fluctuation of this expense between the houses was nominal, ranging from 3.01% to 3.43%.

This department, which handles the bills issued, and the invoices received, the collecting and disbursing of all moneys, is composed ordinarily of the following subdepartments:

Credit	Accounts Payable
Comptometer	Collections
Billing	Cashier
Statistical	

The expenses are distributed as follows, and the percentages shown on the statements are computed on total sales.

Salaries and Expenses of Department Heads: This expense is prorated to subdepartments in accordance with duties performed.

Billing, Comptometer, Statistical: This expense is charged to the different commodities on the basis of the number of items on bills and credit memoranda issued.

Credit, Collections, and Accounts Receivable Bookkeepers: This expense is charged to the different commodities on the number of bills and credit memoranda issued. To obtain the number of bills or credit memoranda issued by commodities, we charged one bill when there was one item on the bill; when there were two or more items of different commodities, the proper fractional proportion of the bill for each item was charged to the different commodities.

Accounts Payable: This expense is prorated to commodities on the number of invoices and credit memoranda received from manufacturers.

Collection Expense and Bad Debts: This expense is prorated to commodities on the basis of sales.

Unclassified Financial and Accounting Expenses: This is allocated

to commodities on the basis of the total direct expense of this department.

Prorated Administrative: The total $44,402 is approximately 13% of the total departmental expense and was prorated to commodities on the basis of the total financial and accounting expense.

As the expenses of this department are generally charged to commodities in accordance with the number of transactions handled, the only method of reducing the comparative expense to sales billed is to decrease the number of transactions on particular commodities for a given amount of sales.

SELLING EXPENSE: The percentages of selling expense are computed on total sales.

This expense covers not only the actual selling, but also the handling of the order from the time it is received until it is turned over to the warehouse for shipment, or on direct sales to the accounting department for billing.

The average total selling expense of the five houses for the year 1921 was 10.28% of sales, and the fluctuations in the different houses range from 9.47% for the low to 12.47% for the high, or about the fluctuations of the total expense of the different houses.

The subdepartments of this major department, in an ordinary jobbing house, are as follows:

Sales Force	City Desk
Quotation	Claim
Order	Purchasing (direct sales)
Pricing and Costing	Service (direct sales)
Editing	Advertising

The selling expense is distributed as follows:

Sales Force: This includes the salaries and expenses of department heads, salesmen and their traveling and entertaining, and is about 70% of the total selling expense.

This is charged to commodities on the basis of time reports made up by each individual. The results were not considered; but the reports were based solely on the effort made by the organization on the different commodities. It is realized that a particular salesman could not itemize the minutes or hours spent on the different commodities, without an error; but a review of the different reports of all salesmen, we believe, would prove to even the most skeptical that the percentage of errors on all salesmen for a particular commodity would be so small that it would not change the result, to affect in any degree the comparisons of expense of the different commodities.

Quotation: This expense is allocated to the different commodities on the number of items on which quotations were made.

Order, Pricing, Costing, and Editing: This expense is divided to commodities on the number of items on bills issued.

City Desk: This expense is prorated to commodities on the number of units handled and on the number of orders received by it and turned over to the warehouse. It does not include the expense of a retail department.

Claims: Clerical work in handling credit memoranda in connection with claims made by customers. This is charged to commodities on the number of items on the credit memoranda issued.

Purchasing: This is divided between the selling and warehousing expense on the basis of the number of items on purchase orders for direct shipments and stock, and that applied to selling is divided to commodities according to the number of items on orders for direct shipments.

Service: This expense is divided between warehousing and selling, on the basis of the number of items on warehouse and direct sales. The proportion charged to direct sales is prorated to commodities on the number of items on bills for direct sales.

Advertising: This is the expense of publication, circulars, and so forth, and is charged to the particular commodity advertised. Any general advertising is allocated on the basis of net sales billed.

Catalogs: This includes the expense of issuing general catalogs, special catalogs, and discount sheets, and is allocated to commodities on the basis of space used.

Unclassified Selling: All possible items included in this expense are allocated to commodities or subdepartments, and the residue is charged to commodities in accordance with the total direct selling expense.

Prorated Administrative: That portion assessed to selling is charged to commodities on the basis of the total selling expense.

Referring to the comparison between wiring devices and rubber-covered wire and lamp cord, we find that the sales force expense for the former is 4.67% of net sales, as compared to 3.5% for the latter, or a difference of 1.17%. This expense is allocated on the effort made. However, the balance of the sales expense is allocated to commodities on the number of items billed and units handled, except the unclassified and prorated administrative expense, and as the total selling expense for wiring devices is 3.34% greater than for rubber-covered wire and lamp cord, the total selling expense and the comparative ratio to sales billed could be considerably reduced, provided the number of items billed and units handled could be decreased for the same amount of billing.

WAREHOUSING EXPENSE: This departmental expense includes the handling of material for stock (receiving and shipping) as well as the clerical work of maintaining stock records and purchasing for stock, and is applied to warehouse sales only.

The fluctuation between the houses was nominal, ranging from 5.81% to 7.21%, with an average of 6.35%.

The subdepartments are as follows:

Purchasing (stock orders)	Checkers
Receiving	Packing
Stock Maintenance	Shipping
Warehouse Men	Service (warehouse sales)

The following explains the distribution of the expense of this department:

Purchasing: This is allocated to commodities on the number of items on orders for merchandise purchased for stock.

Receiving: This expense is prorated to commodities on the basis of units received.

Stock Maintenance: This is the cost of maintaining stock records and is charged to different commodities on the number of items posted.

Warehouse Men: This expense is first divided to the different floors and then prorated to the commodities on the number of units received and shipped.

Checkers: The expense of men checking the material with the order before it is shipped, and is charged to different commodities on the number of units shipped.

Packers: The expense of men packing, excluding packing material, charged to commodities on the basis of the number of packages packed, eliminating all packages which are shipped as received.

Shippers: This expense is charged to commodities on the number of packages shipped.

Service: That portion of expense charged to warehousing is prorated to commodities on the number of items on bills issued for warehouse shipments.

Rent, Light, Heat and Power, Watchmen: This expenditure is charged to commodities according to space occupied.

Insurance and Taxes: This expense on merchandise stock is charged to commodities on the basis of the book value of merchandise on hand at the first of each month. The insurance and taxes on equipment is prorated to commodities on the space occupied.

Cartage In and Out: While general instructions were issued to

Consolidated Summary of Sales, and Statistical Data by Commodities for Five Houses

Twelve Months Ending December 31, 1921

Commodity		Net Sales					
Commodity No.	Description	Warehouse	Per Cent to Total Sales Each Commodity	Direct	Per Cent to Total Sales Each Commodity	Total	Per Cent to Total Sales All Commodities
1	Wiring Devices	$538,517	82.21	$116,553	17.79	$655,070	6.42
2	R. C. Wire and Lamp Cord	468,791	60.56	305,269	39.44	774,060	7.59
3	Weatherproof Wire	162,013	39.41	249,065	60.59	411,078	4.03
4	Bare Copper Wire	20,175	17.50	95,114	82.50	115,289	1.13
5	Rigid Conduit	238,639	80.89	56,374	19.11	295,013	2.89
6	Condulet Type Fittings	131,250	86.88	19,822	13.12	151,072	1.48
7	Outlet Boxes and Other Conduit Fittings	84,164	85.78	13,950	14.22	98,114	.96
8	Metallic Flexible Conduit	94,236	86.62	14,558	13.38	108,794	1.07
9	Non-metallic Flexible Conduit	98,395	95.13	5,016	4.87	103,411	1.01
10	Metal Molding and Fittings	16,542	77.70	4,747	22.30	21,289	0.21

Note: In this and following tables, only ten commodities are shown, out of a list of 39, so that some of the groups or commodities referred to in the report do not appear here.

Percentage Operating Expense to Sales

Commodity		Direct Sales			Warehouse Sales	
Commodity No.	Description	Financial and Accounting	Selling	Total	Warehousing	Total
1	Wiring Devices	5.36	8.73	14.09	6.84	20.93
2	R. C. Wire and Lamp Cord	2.46	5.39	7.85	4.76	12.61
3	Weatherproof Wire	1.70	3.74	5.44	3.69	9.13
4	Bare Copper Wire	1.34	6.46	7.80	4.02	11.82
5	Rigid Conduit	2.14	5.48	7.62	7.67	15.29
6	Condulet Type Fittings	7.56	11.36	18.92	10.58	29.50
7	Outlet Boxes and Other Conduit Fittings	9.04	16.39	25.43	16.82	42.25
8	Metallic Flexible Conduit	2.70	5.64	8.34	4.85	13.19
9	Non-metallic Flexible Conduit	2.51	8.56	11.07	5.20	16.27
10	Metal Molding and Fittings	7.22	21.68	28.90	13.40	42.30

Statistical Data

Commodity No.	Description	Bills and Credit Memoranda Issued	Items on Bills and Credit Memoranda Issued	Average Amount of Items on Bills and Credit Memoranda Issued	Units Received	Commodity No.	Units Shipped	Average Selling Price of Units Shipped	No. of Packages Shipped	Turnover of Merchandise Owned
1	Wiring Devices	38,537	91,036	$ 7.20	21,837	1	361,323	$ 1.49	64,446	2.34%
2	R. C. Wire and Lamp Cord	16,263	31,673	24.44	9,744	2	64,319	7.29	22,401	2.65%
3	Waterproof Wire	3,074	5,173	79.47	4,294	3	10,062	16.10	5,772	4.93%
4	Bare Copper Wire	532	660	174.68	62	4	933	21.62	497	1.21%
5	Rigid Conduit	4,892	12,524	23.56	24,296	5	75,115	3.18	36,377	2.80%
6	Condulet Type Fittings	11,631	38,066	3.97	10,325	6	124,875	1.05	22,506	2.02%
7	Outlet Boxes and Other Conduit Fittings	9,787	29,306	3.35	8,135	7	168,712	.50	25,465	1.40%
8	Metallic Flexible Conduit	2,653	5,107	21.30	5,806	8	16,323	5.77	6,499	3.29%
9	Non-metallic Flexible Conduit	2,406	4,646	22.26	10,000	9	15,620	6.30	9,643	5.00%
10	Metal Moldings and Fittings	1,632	5,384	3.95	2,403	10	15,939	1.04	2,925	1.83%

(Report of Operating Expenses by Commodities for Five Electrical Jobbing Houses, Calendar Year, 1921, Submitted by the Subcommittee of the Accounting and Statistics Committee of the Electrical Supply Jobbers Association, May, 1922.)

properly divide this expense, no specific rule could be applied to all houses because of the varying methods. In some cases houses pay for their cartage on the basis of weight, and as each package is charged separately, the expense can be allocated exactly. In other cases, for cartage in, we made special studies of carload shipments, ascertaining the cost of cartage at the different houses for a particular commodity. Less-than-carload inbound cartage and all outbound cartage were distributed to commodities, by considering the number of packages, weight and length of haul excluding all free or bulk deliveries and collections, such as express.

Packing Material: This expense is allocated to commodities on the number of packages packed, considering the packing material required.

Unclassified Warehousing: This expense is divided on the same basis as the direct warehousing expense, after charging to subdepartments or commodities all possible expense.

Prorated Administrative: This is charged to the different commodities on the basis of the total warehousing expense.

In comparing the cost of this departmental expense for wiring devices and rubber-covered wire and lamp cord, we find that considering the volume of business, wiring devices has a larger number of items on purchase orders, units on receiving reports, items on warehouse sales and receiving reports, units on warehouse sales and receiving reports, units on warehouse sales; also items on bills and credit memoranda issued. Therefore, notwithstanding a lower percentage cost of rent, light, heat, power and watchmen which is distributed according to space occupied, for wiring devices than for rubber-covered wire and lamp cord, the total expense is over 2% higher. This again demonstrates that to comparatively reduce warehousing expense of a commodity, we must reduce the number of transactions and units handled.

A sample of results of the study is shown in the tables on pages 578, 579, and 580.

44. THE HEREFORD RANCH—RANCH COST ACCOUNTING

The Hereford Ranch comprises about 4,000 acres, a part of which is owned by the proprietor, and a part rented. Rentals are on the share basis. The rented portion of the farm includes somewhat more than one-half of the total area, and the rentals amount to approximately one-third or one-fourth of the total produce. The crops raised are wheat, barley, corn, beans, and hay. Three farms constitute the ranch; two of these are located

in delta land, the third in the uplands. The acreage devoted to different crops varies from year to year, depending upon the crop grown on that ground the preceding year, the nature of the soil itself, the climatic conditions, and the relative estimated profits to be made in the light of the prevailing market tendencies.

Some live stock is raised. About 300 head of sheep are run on the uplands to keep weeds and foul growth cleaned out, and also because of the little care required to raise them in proportion to the use they serve and the income to be gotten from the sale of wool and live animals for slaughter. Between 50 and 100 hogs are held in pens and fattened for market on corn and inferior grain which does not bring a fair market price. A few head of cattle are also raised.

About 30 head of horses are kept for farm work. By far the greater part of the tilling and handling of the crops is done by machinery. Three tractors, three grain harvesters, and one bean harvester, as well as tillage and hay-making machinery are employed in the operation of the ranch.

A foreman is in charge of each farm. As well as supervising the actual work, he keeps the time of the workmen and reports their time, their debits, and wage rate to the proprietor whenever such workmen leave his employ, at which time settlement is made. Workmen do not usually stay as long as a year, and in such cases a cash settlement is made with them upon their leaving the ranch. If they are transferred from one foreman to another foreman upon this ranch, they receive slips from the foreman with whom they have been working by which they are able to get credit from the foreman to whom they are transferred. If they stay more than a year, the cash settlement for wages takes place yearly.

Tilling varies with the crops to be planted, as follows:

1. *Wheat and Barley:* The ground is ploughed, disked, and harrowed (one or more times depending upon the mellowness of the soil and the foul growth to be killed) drilled, and when the crop is ripe, harvested. The grain is hauled by horses to the river bank for shipment to market, or to the granaries for storage.

2. *Corn:* The ground is ploughed, disked, and harrowed to the proper fineness. Corn is then planted in rows by a two-horse planter. After the corn has grown a few inches above the ground the rows are cultivated with a two-horse cultivator and men with hoes cut any weeds not cut by the cultivators. Suckers must also be cut off the

corn stalks by men working through the fields. When ripe, the corn is shucked and hauled to cribs to be cured. It is later shelled in a sheller. A small part of the cob corn is kept for hog feed.

3. *Beans:* The ground is ploughed, disked, harrowed, and planted similarly to corn. The bean rows are cultivated and hoed in the same manner. When ripe, the beans are cut by a two-horse cutter, piled and rowed by men with pitch forks, and then threshed by a moving combined harvester. The threshed and sacked beans are then hauled to the storehouses or to the river bank for shipment.

Employees are all paid a daily wage, in addition to their found.[1] Foremen are paid by the month. Repairs to machinery are made during slack periods between the busy seasons.

The problem to be solved for this ranch is to devise an accounting system by which the cost of producing the various crops, and raising live stock, can be ascertained, and to develop a system by which the control of the business can be kept well in hand. It is not deemed practical to develop too great accounting refinements in cost determination and distribution because the operation of such a system would be more cumbersome than practical for the person who is to handle it.

Each man takes care of his own team and this comprises practically all of the attention that is necessary for the care of the horses. Grain for seed purposes is taken from regular stock of grain produced. Before being sown it is put through a cleaning process and also through a process of bluestoning in which certain chemicals are used to clean the seed further.

The ranch consists in all of 19 fields varying in size from 75 up to 600 acres each.

[1] "Found" includes living quarters for the men, and all food and supplies necessary for their maintenance.

REFERENCES

A. MINING AND LUMBERING

CHARLTON, W. H. *American Mine Accounting.* McGraw-Hill Book Co., New York, 1913.

DICKSEE, LAWRENCE R. *Mines Accounting and Management.* Gee & Co., London, England, 1914.

FINLAY, JAMES R. *The Cost of Mining,* pp. 39-51. McGraw-Hill Book Co., New York, 1921.

GARDINER, R. W. "Coal Production Costs," *N. A. C. A. Official Publications,* Vol. II, No. 17.

HOOVER, HERBERT C. *Principles of Mining,* pp. 169-177, 1909.

IBOTSON, J. G. P. "Quarry and Stone Merchants' Accounts," *Accountants' Library,* Vol. XXVII. Gee & Co., London, England, 1904.

JENSEN, WILHELM. "Logging in Western Washington," *Journal of Accountancy*, Feb., 1916, pp. 125-135.
JONES, ARTHUR F. *Lumber Manufacturing Accounts*, Ronald Press Co., New York, 1914.
KELLOGG, R. S. *Lumber Industry*, pp. 58-86. Ronald Press Co., New York, 1914.
LAWN, JAMES G. *Mine Accounts and Mining Bookkeeping*, Sixth Edition. Charles Griffin & Co., London, England, 1909.
MAHONY, J. "Practical Sawmill Accounting," *American Lumberman*, March 25, 1922, p. 66; April 15, pp. 62-64; June 17, pp. 66-68.
MCGARRAUGH, ROBERT. *Mine Bookkeeping*. McGraw-Hill Book Co., New York, 1920.
MCGRATH, F. O. *Mine Accounting and Cost Principles*. McGraw-Hill Book Co., New York, 1921.
MORROW, M. B. "Essential Items of Cost in Production of Coal," *Proceedings of Thirteenth Annual Convention of International Railway Fuel Association*, pp. 92-102, Chicago, May, 1921.
PICKERING, J. G. "Cost Keeping for Small Metal Mines," *United States Bureau of Mines, Technical Paper No. 223*. 1919.
REDEMSKI, A. J. "Some Questions in the Determination of Lumber Costs," *N. A. C. A. 1920 Year Book*, pp. 59-64.
REED, W. B. *Bituminous Coal Mining Accounting*. McGraw-Hill Book Co., New York, 1922.
REED, W. B. "Cost Accounting in the Bituminous Coal Industry," *Coal Review*. A series of weekly articles running from August 17, 1921, to March 15, 1922.
REED, W. B. "How to Charge Supplies," *Daily Digest*. National Coal Association, Washington, D. C. A series of articles running from October 29, 1918, to March 5, 1919.
STEER, W. R. "Lumber Production Costs in Grades," *American Lumberman*, Oct. 8, 1921, pp. 56-57; Oct. 15, 1921, pp. 54-55.
WALLACE, DAVID. *Simple Mine Accounting*. McGraw-Hill Book Co., New York, 1909.
——— "Uniform Cost Sheet," *Coal Age*, September 19, 1918, pp. 545-547.
——— "Costs of Operation of Shoveling Machines in Mines," *Coal Age*, May 18, 1922, pp. 833-839.
——— "Lumber Costs," *N. A. C. A. Bulletin, No. 40*, Nov. 15, 1922, pp. 451-452.
——— *Uniform Cost Accounting System*, West Coast Lumberman's Association, Seattle, 1919.

B. HARDWARE AND METALS

ALDRICH, JOHN G. "Ten Years of Scientific Management," *Management Engineering*, Feb., 1923, pp. 87-100.
BALLARD, E. H. "Comparing Costs of Steel Making," *Foundry*, Sept. 1, 1920, pp. 687-688.
BARRETT, D. O. "Cost System for a Medium Size Foundry," *Iron Age*, Oct. 3, 1918, pp. 810-813.
BARUCH, ALFRED. "Standardized Costs for Sheet Metal Workers," *Sheet Metal Worker*. A series of articles running from Oct. 14, 1921, to Oct. 13, 1922.
BELT, ROBERT E. *Foundry Cost Accounting—Practice and Procedure*.
BELT, ROBERT E. "Cost Data Essential to Foundries," *The Foundry*, Dec. 15, 1921, pp. 966-969.
BEST, J. W. *The Cost Accounts of an Engineer and Ironfounder*. Gee & Co., London, England, 1901.
BIRD, WILLIAM W. "Foundry Cost and Accounting System," *Foundry*, June, 1918, pp. 256-258.
CLARK, J. R. "Handling Factory Costs; How a Foundry Gathers Them," *Factory*, June, 1918, pp. 1202-1208.
CRITCHLOW, P. C. "Foundry Organization for Costs and Records," *The Foundry*

Trade Journal, London, England, Jan. 19, 1922, pp. 45-48; Jan. 26, 1922, pp. 66-68.

DILLER, H. E. "System Controls Foundry Output," *Iron Trade Review,* July 20, 1922, pp. 173-177.

DWYER, P. "Costs Dictate Changes in Molding," *The Foundry,* July 1, 1921, pp. 501-509.

EGGLESTON, DEWITT C. *Problems in Cost Accounting,* pp. 136-139, 256-268.

GEFFERY, G. J. B. "Brass Foundry Costs," *The Cost Accountant,* Aug., 1921, pp. 50-52; Sept., 1921, pp. 68-71.

JENSEN, CARL B. "Cost Problems in the Wrought Iron Industry," *N. A. C. A. Official Publications,* Vol. IV, No. 8.

JORDAN, JOHN P., and HARRIS, GOULD L. *Cost Accounting,* pp. 254-281.

KELLER, H. C. "System Keeps Tab on Foundry Costs," *The Foundry,* April 15, 1922, pp. 309-310, 315.

KENT, WILLIAM. *Bookkeeping and Cost Accounting for Factories,* pp. 71, 171-179.

KNOEPPEL, C. E. "A Standard Foundry Cost System," *The Foundry,* May 15, 1920, pp. 407-413; June 1, 1920, pp. 438-442; June 15, 1920, pp. 474-480.

KNOEPPEL, C. E. "How to Get Back to Normal Quickly," *The Foundry,* March 1, 1921, pp. 176-178; March 15, 1921, pp. 223-224.

MAY, H. B. "Obtaining Engineering Costs in the Foundry and Machine Shop," *Iron Trade Review.* A series of articles running from Nov. 10, 1921, to Jan. 19, 1922.

NICHOLSON, J. LEE, and ROHRBACH, JOHN F. D. *Cost Accounting,* pp. 28-29, 32.

POTTER, M. H. "Manufacturing Cost Systems," *Metal Industries,* Aug., 1919, pp. 366-368.

SCOVELL, CLINTON H. *Cost Accounting and Burden Application,* Chapter XVI.

STERLING, D. T. "How Foundry Costs Control Foundry Practice," *Industrial Management,* Jan., 1922, pp. 3-6.

WOODS, KEITH B. "Cost Accounting in the Manufacture of Iron and Steel Sheets," *N. A. C. A. Official Publications,* Vol. IV, No. 4.

——— "A Costing System for the Brass and Copper Tube Industry," *The Cost Accountant,* Nov., 1921, p. 107; Dec., 1921, pp. 127-130; May, 1922, pp. 276-279.

——— "Standard Foundry Cost System," *Foundry,* May 15 to June 15, 1920, pp. 407-413, 438-442, 474-480.

C. MACHINERY AND TOOLS

BUNNELL, STERLING H. "Cost Keeping for Small Machine Shops," *American Machinist,* Vol. XXXIII, No. 22.

COLVIN, F. H. "Cost Keeping in the Small Shop," *American Machinist,* Sept. 2, 1920, pp. 442-443.

DOXSEY, W. S. "Compiling Cost Data in a Naval Steel Foundry," *Foundry,* April 15, 1919, pp. 206-211.

DREFS, A. G. *Journal of the Society of Automotive Engineers,* July, 1920, pp. 33-38.

EGGLESTON, DEWITT CARL. *Problems in Cost Accounting,* pp. 256-568, 296-305.

FISCHER, A. K. "Accounting for a Cast Iron Pipe Foundry," *Journal of Accountancy,* March, 1920, pp. 180-189.

GATTER, L. S. "Finding the Cost of Ordnance," *American Machinist,* April 3, 1919, pp. 657-660.

KEEFE, JOHN J. "Cost Accounting in the Tool Steel Industry," *N. A. C. A. Official Publications,* Vol. IV, No. 11.

KENT, WILLIAM. *Bookkeeping and Cost Accounting for Factories,* pp. 67-69, 192-202.

KNOEPPEL, C. E. *Maximum Production in Machine Shop and Foundry,* pp. 31-53, 95-127, 268-365. Engineering Magazine Co., New York, 1911.

KOSKEY, G. H. "Cost and Production Records," *Forging and Heat Treating*, May, 1922, pp. 230-235.
MILLER, FRANKLIN. *Uniform Cost System Designed for National Machine Tool Builders' Association.* Miller, Franklin-Basset & Co., 1920.
OBERG, E. "Time Study and Rate Setting in a Machine Tool Plant," *Machinery*, July, 1919, pp. 1051-1055.
PERRY, KEENE L. "Cost Control in the Motor Car and Allied Industries," *The Cost Accountant.* A series of articles beginning Sept., 1922.
POPCKE, A. G. "Relation of Quantity Production to Cost," *Industrial Management*, Jan., 1918, pp. 54-61.
SHANER, E. L. "Controlling Production in a Jobbing Shop," *Iron Trade Review*, Sept. 4, 1919, pp. 623-629.
STOTENBUR, P. E. "Cost Accounting for Cranes and Hoists," *N. A. C. A. Official Publications*, Vol. IV, No. 10.
THOMAS, WILLIAM A. "Machine Shop Costs," *N. A. C. A. Bulletin No. 26*, May 1, 1922, pp. 227-230.
VAN DEVENTER, JOHN H. *Handbook of Machine Shop Management*, pp. 225-233, 1915, "Assemblies," *N. A. C. A. Bulletin No 1*, March 15, 1922, pp. 4-6.
——— "Sub Assemblies," *N. A. C. A. Bulletin No. 1*, March 15, 1922, pp. 4-6.

D. FOOD PRODUCTS AND CHEMICALS

BUSH, H. J. "Cost Systems in Sulphuric Acid Works," *Chemical Age*, July 5, 1919, pp. 58-59.
COLEMAN, E. J. "Cost Accounting in the Canning Industry," *N. A. C. A. Official Publications*, Vol. III, No. 17.
GOULD, G. "Cost per Pound of Good Bread," *The National Baker*, May, 1921, p. 36.
GREEN, WESTON H. and MURPHY, HARRY. "Uniform Methods in the Biscuit and Cracker Industries," *N. A. C. A. 1921 Year Book*, pp. 162-166.
KOCH, WILLIAM C. "Cost Accounting in the Soap Industry," *N. A. C. A. Official Publications*, Vol. III, No. 7.
LANHAM, H. "Brewers' and Bottlers' Accounts," *Accountants' Library*, Vol. XLIV. Gee & Co., London, England, 1916.
MORAN, D. L. "Process Costs for Biscuit Manufacturers," *The Cost Accountant*, Oct., 1921, p. 78; Nov., 1921, p. 105; Dec., 1921, pp. 124-126.
MUIR, DAVID. "Flour Mill Costing," *Business Organization and Management*, Aug., 1922, pp. 497-504.
MULHERN, J. J. and ROBERT, U. "Cost Accounting in the Oil Refining Industry," *N. A. C. A. Official Publications*, Vol. III, No. 18.
NARLIAN, C. A. H. "Flour Milling Costs," *N. A. C. A. Official Publications*, Vol. III, No. 15.
PUTNAM, L. L. "Accounting Problems in Sugar Factories," *Sugar*, Aug., 1922, pp. 438-439.
REA, GEORGE. "Chocolate and Cocoa Costs," *N. A. C. A. Official Publications*, Vol. III, No. 20.
RICHARDSON, G. H. *Cocoa, Chocolate and Confectionery Manufacturers' Accounts*, Gee & Co., London, England, 1922.
ROSEN, C. B. E. "Some Phases of Cost Accounting in the Chemical Industry," *N. A. C. A. Official Publications*, Vol. III, No. 6.
SCOVELL, CLINTON H. *Cost Accounting and Burden Application*, Chapter XVIII.
SHEPPARD, C. C. "Cost Practices and Problems in the Production of Coke," *N. A. C. A. Official Publications*, Vol. IV, No. 6.
THORNTON, FRANK W. *Brewery Accounts*, Ronald Press Co., New York, 1913.
TYRRELL, S. C. "Costing as Applied to the Drug Branch of the Chemical Industry," *Cost Accountant*, Jan., 1923, pp. 259-271.
WHITE, RODNEY D. "Salmon Canning Costs," *N. A. C. A. Official Publications*, Vol. III, No. 21.

——— "Uniform System of Accounts for Gas and Electric Companies," *Department of Public Utilities of Massachusetts*, First Issue, July 1, 1921.
——— "Bakery Accounting System (American Bakers' Association)," *The National Baker*, Sept., 1921, p. 35.
——— "Cost Analysis in Chemical Manufacturing," *Journal of the Society of Chemical Industries*, June 30, 1919, p. 224, R-6R.

E. TEXTILES

BARKER, A. F. and EBER, MIDGELY. *Analysis of Woven Fabrics*, pp. 229-253. D. VanNostrand Co., New York, 1914.
BENNETT, CLINTON W. "Determining Woolen Mill Costs," *Management Engineering*, Aug., 1922, pp. 91-94.
BENNETT, C. W. "Woolen Mill Costs," *N. A. C. A. Official Publications*, Vol. IV, No. 2.
BOUTELLE, E. G., et alii. "Cost Problems of the Textile Industry," *N. A. C. A. 1922 Year Book*, pp. 319-364.
BOUTELLE, E. G. "Essential Reports of Textile Executives," *Textile World*, Feb. 3, 1923, pp. 200-203.
DALE, S. S. *Cost Finding in Woolen and Worsted Mills, Textiles*, 79 Milk Street. Boston, 1920.
EGGLESTON, DEWITT CARL. *Cost Accounting*, pp. 363-401.
EVERS, W. F. "Cost Methods in a Hosiery Mill," *N. A. C. A. Official Publications*, Vol. IV, No. 1.
GILL, S. L. "Textile Costs," *The Cost Accountant*, Feb., 1922, pp. 167-171.
GORDON, STEPHEN R. "Cost Finding in Knitting Mills," *Textile World*. A series of articles in April 15, 1922, and later issues.
HARDMAN, A. H. *Business Organization and Management*, "Costing in the Textile Industries," Nov., 1919, pp. 25-30; "Yard and Cloth Costing in Cotton Mills." A series of articles from Jan. to May, 1920.
HASKELL, H. C. "Textile Cost Control," *Management Engineering*, Jan., 1923, pp. 57-59.
KENT, WILLIAM. *Bookkeeping and Cost Accounting for Factories*, pp. 206-208.
KLIMMER, GEORGE D. "Methods of Accounting for Waste in a Cotton Spinning Mill," *N. A. C. A. Official Publications*, Vol. III, No. 9.
MUNROE. "Calculation of Card Room Costs," *Textile World*, April 26, 1919, pp. 253-259.
NICHOLS, H. W. *Method of Determining Costs in a Cotton Mill*, H. W. Nichols, New Bedford, Mass., 1915.
NICHOLS, WILLIAM G. *Methods of Cost Finding in Cotton Mills*.
SCOVELL, CLINTON H. *Cost Accounting and Burden Application*, Chapter XVII.
STEVENSON, CHARLES R. *Textile World*, April 24, 1920, p. 3051 and following.
SWEETSER, F. F. "Uniform Standard Cost Accounting Methods in the Garment Industry," *N. A. C. A. 1921 Year Book*, pp. 155-161.
SZEPESI, EUGENE. *Cost Control and Accounting for Textile Mills*, Bragdon, Lord & Nagle Co., New York, 1922.
SZEPESI, EUGENE. "Textile Mill Organization and Costs," *Textile World Journal*. A series of articles beginning Feb. 17, 1917.
SZEPESI, EUGENE. "Making Textile Cost Accounting a Necessity," *Textile World*, Oct. 14, 1922, pp. 49-50, 114.
UNION, CHESTER R. "Uniform Accounting in the Textile Industry," *Journal of Accountancy*, Feb., 1920, pp. 104-112.
WHITING, GRAFTON. "Textile Cost Accounting," *Textile World*, Jan. 11, 1919, p. 140.
——— "Installing Standard Cotton Mill Cost System," *Textile World*, July, 1922, pp. 55, 117-119.
——— *Report of the Committee on Production Costs*, National Association of Cotton Manufacturers.

F. RUBBER AND LEATHER

EGGLESTON, DEWITT CARL. *Problems in Cost Accounting*, pp. 9-17, 42-45, 50-52, 250-254.

FEIL, G. J. J. "System of Costing Used in Boot Factories," *Accounting and Commerce*, Jan., 1919, pp. 234-237; Feb., 1919, pp. 255-259.

FLETCHER, F. R. "An Outline of the Use of Standards in Shoe Manufacturing," *N. A. C. A. 1922 Year Book*, pp. 157-191.

HEADEY, L. C. *Boot and Shoe Costings*, Gee & Co., London, England.

JORDAN, JOHN P. and HARRIS, GOULD L. *Cost Accounting*, pp. 35-36.

KIRBY, F. G. "Cost Accounting in the Rubber Industry," *The India Rubber World*, Dec. 1, 1920, pp. 155-157; Jan. 1, 1921, pp. 241-242.

LENGS, H. AUSTIN. "Cost Accounting Suggestions for Rubber Plants," *India Rubber Review*, Jan. 15, 1921.

MAYNARD, B. M. "Using Time Studies in a Tire Factory," *India Rubber World*, Mar. 1, 1922, pp. 415-417.

MENDENHALL, W. B. "Production Control in a Tire Manufacturing Plant," *The India Rubber World*, Aug. 1, 1922, pp. 729-732.

RUSS, W. W. and SMALL, F. L. *Scientific Allowance and Cost System for Upper Leather Cutting in Shoe Factories*, Shoe Trade Publishing Co., Boston, 1922.

SEARS, FRANK W. "Sole Leather Department Costs," *N. A. C. A. Bulletin No. 22*, pp. 163-166, Mar. 1, 1922.

SMALL, L. *Treatise on Comprehensive Accounting Methods Adapted to Shoe Manufacturing and Other Industries*, L. & S. Printing Co., Boston, 1914.

STEWART, R. S. and EBBELS, F. C. *Rubber Companies Accounts for Non-Producing and Producing Companies*, Gee & Co., London, England, 1916.

WHITMORE, JOHN. "Shoe Factory Cost Accounts," *Journal of Accountancy*, May, 1908, pp. 12-25.

ZINN, ROLAND H. "Uniform Cost Accounting Methods in the Tanning Industry," *N. A. C. A. 1921 Year Book*, pp. 167-175.

——— "Hollerith System of Card Entries and Accounting in a Shoe Factory," *Shoe Factory*, Feb. 6, 1913, pp. 24-33.

G. OTHER INDUSTRIES

BIGELOW, CARLE M. *Installing Management in Woodworking Plants*, pp. 58-72, 201-226, 233-248, 259-314, Engineering Magazine Co., New York, 1920.

BISTLINE, E. D. "Cost Accounting for Public Utilities," *N. A. C. A. Official Publications*, Vol. II, No. 9.

BORTON, C. J. "Production Costs in the Manufacture of Phonograph Records," *N. A. C. A. Official Publications*, Vol. IV, No. 7.

CORNELL, C. D. *Farm Accounts*, Isaac Pitman & Sons, New York, 1919.

DAVIS, A. E. *How to Find Costs in Printing*, Oswald Publishing Co., New York, 1914.

GOODYEAR, L. E. *Farm Accounting for the Practical Farmer*, Goodyear-Marshall Publishing Co., Cedar Rapids, Iowa.

HAENISCH, F. A. "Some Cost Problems in the Hawaiian Sugar Industry," *N. A. C. A. Official Publications*, Vol. III, No. 4.

HANSON, M. "Cost Accounting in Products Manufacture," *Concrete*, June, 1922, pp. 235-238; July, 1922, pp. 33-36; Aug., 1922, pp. 66-68.

HOLLISTER, HORACE E. *Practical Garage Accounting*, Garage Systems Co., Rockford, Ill., 1916.

JORDAN, JOHN P. and HARRIS, GOULD L. *Cost Accounting*, pp. 31-33, 145-146.

LAKIN-SMITH, H. "Printers' Accounts," *Accountants' Library*, Vol. XVII, Gee & Co., London, England, 1902.

LATTA, W. "Accounting for a Newspaper," *The Pace Student*, Feb., 1923, pp. 36-39.

LAWRENCE, W. B. "Uniform Cost Accounting Methods in the Printing Industry," *N. A. C. A. Official Publications*, Vol. II, No. 18.

MILLER, EDWARD T. "Operation of the Printers' Standard Cost System and Some Results," *N. A. C. A. 1921 Year Book*, pp. 143-154.

MOZINGO, F. P. "Cost Accounting and System Accounts for the Manufacture of Cigar Boxes and Dovetail Packing Boxes," *Business Man's Magazine*, Sept., 1909, pp. 252-257.

POTTER, H. D. "Cost Finding in Furniture Factories," *The Furniture Manufacturer and Artisan*. Articles monthly during 1922.

SCOVILL, H. T. *Farm Accounting*, D. Appleton & Co., New York, 1918.

TIMKEN, FRANK H. *Accounting in the Furniture and Woodworking Industries*. Trade Periodical Co., Chicago, 1915.

WILLIAMSON, A. "Costing in the Printing Trades," *The Cost Accountant*, Feb., 1922, pp. 172-173.

——— "A Costing Scheme," *Box Makers' Journal*, July 31, 1918, pp. 12-16.

——— *A Standard Cost Finding System*, United Typothetae of America, 1920.

——— "Cost Finding for Paperboard Manufacturers," *Boxboard*. A series of articles beginning May, 1922.

——— "Gas Accounts," *Accountants' Library*, Vol. VII, p. 112, Gee & Co., London, England, 1905.

——— *Michigan Agricultural Experiment, Quarterly Bulletin*, Feb., 1920, pp. 109-112.

——— "Newspaper Costs," *N. A. C. A. Bulletin No. 23*, Mar. 15, 1922, pp. 177-178.

——— "The Glass Industry," *United States Bureau of Foreign and Domestic Commerce*. Miscellaneous Series No. 60, pp. 66-75, 319-333.

——— "Uniform Estimating and Cost Finding Systems," *Box Makers' Journal*. A series of articles beginning Feb. 18, 1918, through Oct. 31, 1918.

VII

EXECUTIVE PROBLEMS INVOLVING THE USE OF COST DATA

I. THE SENECA FLOUR MILLING COMPANY—SELECTION OF COST UNIT

PREVIOUS to 1919, the Seneca Flour Milling Company had no labor statistics. At that time, however, the factory payroll was analyzed to show labor costs by departments in per barrel units. This cost unit has since proved to be unsatisfactory for comparative purposes in the packing and loading departments.

The cost of packing the same amount of flour in 2-pound bags is much greater than the cost of packing it in 49- or 98-pound bags, and it is unfair to compare the cost per barrel for one mill which packs mostly small-size containers, with the cost per barrel of a mill which packs large-size containers. In order to make the operating and loading labor costs comparable, the foremen

Size	Material	Number Men in Crew	Barrels per Day	Barrels per Man-Hour
2	Paper	4	102	3.19
3.5	Paper	4	134	4.19
10	Paper	4	332	10.38
24.5	Paper	3	400	16.67
49	Paper	3	400	16.67
50	Tin-Navy	3	255	10.63
2	Cotton	4	64	2.00
3.5	Cotton	4	143	4.47
10	Cotton	4	332	10.38
24.5	Cotton	3	400	16.67
49	Cotton	3	400	16.67
98	Cotton	2	350	21.88
98	Double	3	350	14.58
196	Double	3	350	14.58
98	Jute	2	350	21.88
140	Jute	2	350	21.88
280	Jute	2	400	25.00

of the packing and loading departments in the different mills agreed on the 49-pound bag as a basis, stating that 400 barrels of flour a day could be packed in 49-pound bags by three men. On this basis, the schedule on the opposite page was prepared.

In opposition to the proposed plan, the cost accounting department recommended that the packing and loading foremen should keep time cards indicating the sizes of containers used and the number of barrels of flour packed or loaded. It was believed that such cards would provide an absolute check on the efficiency of each packing crew. Because of the detail involved in the keeping of time cards, the general manager of all the mills hesitated to approve the accounting department's proposal.

Which method of keeping records of labor costs should be used by the Seneca Flour Milling Company?

2. JORDAN CONSTRUCTION COMPANY— SELECTION OF COST UNIT

In the cost accounting system of the Jordan Construction Company the labor costs are computed in varying units. The cost of placing re-enforcing steel is calculated by the ton, the cost of pouring concrete by cubic yards, and the cost of making and erecting forms by square feet. More time is required, however, to place a ton of ⅜-inch steel weighing .38 pounds per lineal foot than to place a ton of 1-inch steel weighing 2.69 pounds per lineal foot. Concrete can be more readily poured if a straight solid wall is being built than for a narrow one with decorations; and in addition the cost of making and erecting the forms for fancy construction is more.

Weekly labor reports are sent to the head office from each job showing the cost of each type of work and its degree of completion. Since the cutting, bending, and placing of steel are estimated at an average price per ton, the timekeeper determines the extent of completion by comparing the weight of steel already placed with the total weight of that to be placed. That the results have been misleading was indicated by one job where 45 tons of slab steel were placed at an average labor cost of $14 per ton, while the last 15 tons on the same job, consisting entirely of ⅜-inch steel, were placed at an average labor cost

of $21 per ton. The question has risen, therefore, as to the proper unit of estimating and reporting construction work.

The estimating department has prepared statistical charts to assist it in estimating more accurately the cost of future work. The costs of laying various weights of steel, records of which have been kept for individual jobs, have been plotted on a graph. Although the cost is calculated at 30 cents per hour for steel men, this may be adjusted to agree with the current wage schedule.

Should the units of cost be changed on the weekly reports, or should the present reports be compared with the graph and allowances made accordingly?

3. THE BIRCH CORNER MILLS—EXPANSION OF GREY CLOTH PRODUCTION FACILITIES

In the spring of 1922 the Birch Corner Mills contemplated the expansion of its production facilities to take care of an increase in business expected to materialize with the upward swing of the business cycle. Since the cost of production in the company's mill in Piedmont, South Carolina, had been lower than that of the mill in Fall River, Massachusetts, the company was considering the advisability of expanding the southern mill instead of the northern mill as originally planned. The relative costs of production during 1920-21 in the two mills are shown in the tables on pages 593 and 594.

The labor figures in these tables include charges for both direct and indirect labor. Supplies include replacements of worn textile machinery parts, oil, sizing material, sweeping compound, and other small items. The expense figure includes administration, office expense, and power. Freight is figured in the cost per pound of the grey cloth produced in the southern mill because of the necessity of allowing for freight charges to finishing plants in the North.

The difference in labor costs between the two mills was due partly to the lower wage rate paid in the South and partly to the longer hours worked. The average rate paid to mill operatives in Piedmont was $14.88 for a week of 55 hours compared to $22.28 for a 48-hour week in Fall River. The hourly wages in the southern mill were 27.05 cents as contrasted with the Fall River rate of 46.4 cents.

ESTIMATED COST PER POUND OF MANUFACTURING ALL-COTTON CLOTH MADE EACH MONTH AT FALL RIVER, MASSACHUSETTS, DURING YEARS 1920 AND 1921 AND THE ACTUAL COST PER POUND FOR THE SIX-MONTH PERIODS

	Labor Cents	Per Cent	Supplies Cents	Per Cent	Expense Cents	Per Cent	Total Cents
Actual for six months ending June, 1920	18.6774	66.0	4.1201	14.5	5.5277	19.5	28.3252
December, 1920	20.8681	66.6	4.0629	13.0	6.3892	20.4	31.3202
1921							
January	17.1953	63.6	3.1478	11.7	6.6789	24.7	27.022
February	17.2413	60.5	4.3989	15.5	6.8433	24.0	28.4835
March	16.8595	63.1	3.6635	13.7	6.1847	23.2	26.7077
April	16.1747	64.9	3.2062	12.9	5.5461	22.2	24.927
May	16.4896	65.3	3.3296	13.2	5.4319	21.5	25.2511
Actual for six months ending June 30	16.6343	65.9	3.3767	13.4	5.2164	20.7	25.2274
July	16.3240	69.8	2.0043	8.6	5.0398	21.6	23.3681
August	16.6437	66.4	3.0573	12.2	5.3502	21.4	25.0512
September	16.6610	63.6	3.1733	12.1	6.3545	24.3	26.1888
October	15.6008	66.8	3.0133	12.9	4.7426	20.3	23.3567
November	15.7241	66.8	2.9708	12.6	4.8361	20.6	23.5310
Actual for six months ending December 31	15.9913	68.7	2.8742	12.4	4.4049	18.9	23.2704

In the South, however, because of the fact that tenements must be provided for operatives and that in some cases entire villages must be constructed, labor costs cannot be accurately determined without including the cost of these tenements. An investigation by the American Cotton Manufacturers' Association determined that the increase in compensation of southern mill operatives on account of village expense amounted to $4.36 per operative per week. This amount was reached on the basis of the cost of a modern mill village with an allowance of 6% interest on investment and 5% depreciation on the buildings.

Although costs at that time favored the southern mill there were other factors entering into the decision. In the first place, the large development of the mills in the South was likely in the near future to be accompanied with a development of labor unions and labor legislation which might offset the wage advantage of the southern mills.[1] Already, in fact, there had been

[1] The growth of the cotton manufacturing industry in the South is shown in the following tables: *(Footnote continued on 595)*

considerable agitation for a 48-hour week instead of the 55- or 60-hour week which was prevalent, and a bill had been proposed

ESTIMATED COST PER POUND OF MANUFACTURING ALL-COTTON CLOTH MADE EACH MONTH AT PIEDMONT, SOUTH CAROLINA, DURING YEARS 1920 AND 1921 AND THE ACTUAL COST PER POUND FOR THE SIX-MONTH PERIODS

	Labor Cents	Per Cent	Supplies Cents	Per Cent	Expense Cents	Per Cent	Freight Cents	Per Cent	Total Cents
Actual for six months ending June, 1920	19.4570	62.7	5.945	19.2	5.0692	16.3	.5633	1.8	31.0345
Dec., 1920	19.9020	61.2	5.6681	17.4	6.2835	19.3	.6946	2.1	32.5481
1921									
January	15.6035	56.2	5.1359	18.5	6.2814	22.6	.7599	2.7	27.7807
February	13.6363	53.2	5.3444	20.9	5.8693	22.9	.7610	3.0	25.6110
March	12.3125	53.3	5.2065	20.8	5.7173	22.9	.7571	3.0	23.9934
April	13.0892	55.9	4.4866	19.2	5.0799	21.7	.7570	3.2	23.4127
May	13.2251	54.7	5.1606	21.4	5.0246	20.8	.7570	3.1	24.1673
Actual for six months ending June 30	13.3065	55.5	5.1270	21.4	4.7810	19.9	.7570	3.2	23.9715
July	12.3684	54.3	4.6953	20.6	4.9665	21.8	.7570	3.3	22.7872
August	12.9168	52.0	5.1785	20.9	5.9795	24.1	.7570	3.0	24.8318
September	12.2885	54.5	4.6004	20.4	4.8877	21.7	.7570	3.4	22.5336
October	* Purchased Yarn		.2552	1.1					
	12.2610	53.6	4.5174	19.7	5.1037	22.3	.7570	3.3	22.8943
November	* Purchased Yarn		.8893	4.0					
	11.8138	52.5	4.6746	20.8	4.3425	19.3	.7570	3.4	22.4772
	* Purchased Yarn		.1898	0.8					
Actual for six months ending December 31	11.8551	53.2	4.9477	22.2	4.5486	20.4	.7570	3.4	22.2932

* This item is for yarn purchased outside instead of spun in mill. This is done when the production of the various counts of yarn is not balanced with the requirements for the numbers of cloth being woven.

(Footnote continued from 593)

ACTIVE COTTON SPINDLES IN THE UNITED STATES
(United States Bureau of the Census)

	1917	1918	1919	1920	1921
Total New England States	17,760,968	17,984,720	18,065,857	18,287,424	18,387,789
Total Other Non-Cotton-Growing States	1,972,109	2,028,882	2,018,838	1,962,546	1,950,590
Total Cotton-Growing States	14,155,758	14,529,063	14,846,239	15,230,983	15,708,988
Total United States	33,888,835	34,542,665	34,930,934	35,480,953	36,047,367

COTTON LOOMS IN SOUTHERN AND NORTHERN STATES

(The following statistics are from the United States Census reports. The States grouped in those reports under the headings New England, Middle Atlantic and North Central are here considered as northern; those grouped under the headings

in the South Carolina legislature in 1921, but had failed to pass.

There were, moreover, many advantages enjoyed by the mill in the North. Although the cloth produced in the two mills was practically of the same grade, better management and more highly skilled operatives gave the northern mills considerable advantage in the amount of output per operative. It was also necessary to include the cost of transportation to northern finishing plants in the cost of production of southern mills, because of competition with northern mills. Since quotations were ordinarily f. o. b. mill, an allowance in price quotation for this item was necessary.

There was, however, an advantage to the southern mill, in that the southern mill could purchase cotton from one-quarter to one-half cent less per pound than the northern mill on account of lower transportation charges. This advantage did not always hold, because the southern mill was not assured of a local supply of the grade used. It was estimated, however, that an average of one-quarter cent per pound differential in favor of the southern mill existed.

Should the Birch Corner Mill expand the production facilities of its mill at Fall River, Massachusetts, or of its mill at Piedmont, South Carolina?

4. LEE MOTORCYCLE COMPANY—PRICE POLICY

In the summer of 1922, the general manager of the Lee Motorcycle Company was considering what reduction should be made in the price of its machines.

In 1921-22 the Lee motorcycle with electrical equipment but without side-car sold for $340, a price which compared favorably with that of competing makes. Although the Lee Company had secured the same proportion of the total sales of motorcycles for the country in 1921 as it had in previous years,

South Atlantic, East South Central and West South Central, and all others are considered southern.)

Year	Southern States	Northern States
1899	115,750	334,932
1904	183,372	357,538
1909	223,403	409,560
1914	263,683	409,071
1919	287,502	404,667

the total volume had continued to decline steadily because of the growing use of cheap motor cars. During 1921 the price of an inexpensive car of well-known make had been reduced to $320, or $20 below that of the Lee motorcycle. This price, however, did not include a self-starter or other equipment amounting to about $100 which the average buyer of the car purchased. Although the trend in motorcycle manufacture had been constantly toward heavier and more powerful machines, which were becoming more expensive to operate, the running cost of the Lee motorcycle was still about one-quarter of that of the most economical automobile. This fact, together with such savings as were possible on storage costs and replacement parts, made it a lower-priced mode of transportation. As long as the first cost of the motorcycle was higher, however, the greater capacity and utility of the automobile made it practically impossible to sell the motorcycle to prospects to whom cheap transportation was the primary motive for buying.

It had been found by the Lee Company that its market was continually increasing among the users who bought a motorcycle not for utility purposes, but for the sport and thrill of driving the highest-powered type of machine on the road. Because of the prejudice which had been aroused in the mind of the public by reckless motorcycle drivers, the management considered this sort of purchaser a bad advertisement, and it was desirous of supplanting this business with the sale of a moderate-priced, moderate-geared machine which would make it possible for the average driver to obtain the speed necessary for enjoyment together with comfortable cheap transportation. Although there was little hope of selling motorcycles to most married men who for less than $100 more could buy a car which would carry the whole family, the management believed that a large potential market existed among young working men without families. Many of these men needed low-cost transportation, but they could not afford the initial cost and upkeep of a car, and the sporting characteristics of the motorcycle might appeal to them.

It was not known how effective a reduction in prices would be in reaching this market, but the manager was desirous of trying to check the decline in volume of Lee sales by cutting the price to as low a point as was possible without endangering prof-

its. Sales efforts were being directed along new lines by using as the leading selling points in advertising the advantages of the motorcycle over the automobile in reaching out-of-the-way places. There was a strong opinion, however, that the most effective measure for checking the trend from motorcycles to cheap cars would be to make the differential in initial cost in favor of the motorcycle as great as possible.

The sales manager estimated that at a reduction of about $30 the sales for 1922-1923 could be maintained at approximately the same volume as in previous years. With a further reduction of $30 it was thought that the sales could be increased about one-third. The head of the accounting department was asked to make a report on his estimate of the cost of manufacture on two bases; one, on a volume of 6,000 motorcycles at $310 each; the other, on the sale of 8,000 motorclycles at $280 each. Costs of materials were declining slowly, and the rates of wages currently paid had fallen about 15%. The cost department made the following estimates:

	Actual for 1921-1922 6,000 Sales		Estimate A 6,000 Basis		Estimate B 8,000 Basis	
List Price		$340.00		$310.00		$280.00
Less Dealer's Profit	30%	102.00		93.00		84.00
Gross Manufacturing Price	100%	$238.00	100.0%	$217.00	100.0%	$196.00
Cost of Material	26%	$ 61.88	25.5%	$ 55.32	27.3%	$ 51.50
Labor—Direct	25%	59.50	23.0%	50.00	25.0%	49.00
Manufacturing Overhead	40%	95.20	42.4%	92.00	40.3%	79.00
Selling Expenses, Advertising, and so forth	5%	11.90	5.1%	11.00	5.1%	10.00
Profit	4%	$ 9.52	4%	$ 8.68	2.3%	$ 4.50

What price should the general manager set for 1922-1923?

5. VAN ROON MILLS—COORDINATION OF SALES AND PRODUCTION [1]

The treasurer of the Van Roon Mills recently has received a recommendation from the company's selling agent to increase the number of its gingham patterns. The acceptance of this recommendation will increase the labor cost per yard and also necessitate the purchase of new equipment.

[1] This problem is stated as it came up in 1921.

At the present time the mill produces ginghams in 10,000-yard sets—not less than one set to a pattern; this permits 84 patterns to be manufactured on the 504 looms in the mill each season. Van Roon gingham, which is one of the best grades produced in America, is sold through a commission agent to wholesalers, to cutters-up, and to about 1,500 retail stores. Patterns for the spring season, which is the season of largest sale, must be in the loom the first of September. Salesmen take the initial orders during the preceding May, June, and July. Although the selling agent usually states tentative prices in advance which rarely exceed the prices finally placed on the goods, frequently the prices are not definitely fixed until September. The line is first shown to the wholesalers and cutters-up and then to the retailers. While orders are being taken, a salesman often makes a recommendation that a specific pattern be run, although the full 240 pieces have not been sold. In that case he assumes the moral responsibility of securing orders for the full set on that pattern. The patterns which are found to be poor sellers are dropped September 1, and then a suggestion is made to each purchaser who has ordered these dropped patterns, that since the pattern probably will not be in favor, it will be advisable for the customer to change his order to more successful patterns.

The selling agent now has recommended that the mill increase its number of patterns by producing ginghams in sets of 5,000 yards each. Since department stores, as well as wholesalers, desire a wide variety of patterns from which to make their selection, the salesmen believe that a line of at least 150 patterns is necessary. Many buyers, too, particularly in department stores, purchase one or two pieces (40 yards each) of all patterns in a line in order to have a variety and also to be sure of having popular patterns when the preference of consumers is manifested. A large line also adds to the reputation of the mill. One foreign manufacturer is able to sell ginghams in the United States at a large differential in price; his line has a high reputation for the variety and style of its patterns. The retail and wholesale buyers seek to protect themselves against fluctuations in demand from one pattern to another by having a wide range of patterns. Price also plays an important part in their selection of ginghams. The retailer usually prices a

line of ginghams at 25 cents, 29 cents, 39 cents, 49 cents, 59 cents, and 69 cents, and buys at cost prices to fit these selling prices. If a manufacturer's price, for example, is set too high to allow a normal margin of profit when the gingham is sold at the retail price of 59 cents, the retailer usually places the selling price at 69 cents or buys a cheaper gingham from another manufacturer to sell at 59 cents. The mill also is obliged to meet the competition of other domestic producers of high-grade ginghams.

To put the recommendation of the selling agent into effect in the mills will increase the cost of the cloth 2 cents a yard if the minimum for a set is reduced to 5,000 yards, 2 cents more if it is changed to 2,500 yards, and an additional 2 cents if it is changed to 1,250 yards.[1] This extra cost will be caused partly

[1] Ginghams are ordered into manufacture in the mills in units known as sets. The number of yards to a set varies in different mills, each one making the number of yards which seems most economical and best adapted to its facilities. The additional expense of decreasing the length of sets is illustrated by taking for an example a typical gingham pattern. After the yarns are spun, it is necessary to determine how many threads of each color are required in the width of the cloth. A 32-inch gingham is made up of approximately 2,500 threads or ends in width. The length of these threads determines the length of a set for a pattern. If five colors of warp yarn are required for the pattern, five separate beams of yarn are made up of the requisite number of threads, each lot being wound on a steel cylinder. For a typical gingham pattern one of these beams contains 500 blue threads, one beam 400 red, one beam 600 green, one beam 700 bleached, and one beam 300 black threads. In making each beam the waste amounts to approximately a yard of warp yarn. This amount of waste is the same whether a set is only 1,000 yards long or 10,000 yards. Since time is lost in starting and finishing a beam, whether it be a long or a short one, long beams save time. The yarn or threads on these beams next go through the dyeing process, which is generally one of the most expensive processes in the mill, and practically the same amount of dye liquid is required to run a short set as to run a long one and the time spent in dyeing each beam is practically the same whether it is long or short. After being dyed, the yarn is delivered in rope form to the beaming room where each of the five colors is put on a separate beam again. The stopping and starting of a beam requires about an equal amount of time for a short length as for a long length. The yarn from all five beams next is wound on to one beam in the dressing department. The five beams are placed one behind the other; the threads of all five are combined into one sheet 54 inches wide and are passed through a dressing solution in the slasher which gives them strength to stand the strain and chafing in weaving. After being immersed, the yarn is drawn over a drying cylinder and through a harness, or comb, which spaces the threads of each color to make the pattern, and wound on a beam which goes into the loom. This process requires about 2½ hours for setting up the beams and running the ends of the thread through the harness, regardless of whether the set is long or short. A 10,000-yard set makes six full loom beams; each beam contains about 1,666 yards of yarn which, when woven, makes 1,600 yards of cloth or 40 pieces, each 40 yards long. A 10,000 set thus produces 240 pieces during a season on six looms. In addition to the extra machinery and time required for short sets in this process, there also are losses in production and waste in the weaving department. The production time in the weaving department is about 16 weeks. One

by the loss in waste and by production expenses in the mill and partly by the increased fixed charges on new equipment required. It is estimated that 12 slashers will be required instead of the 8 now used, 40 warpers instead of 30, and 32 beamers instead of 24. This machinery investment, together with additional vats required in the dyehouse, will amount to approximately $40,000. There also will be additional expense in manufacturing "suggestions" [1] and in providing the additional samples required if a greater number of patterns are made. At the present time approximately 12,000 yards of cloth are used each year in getting out designers' suggestions; this necessarily will be increased to 24,000 yards if the number of patterns is doubled; the additional cost for this item at current prices will be $5,100 a year. The mill gives away about 22,000 yards of cloth each year as samples; this will be increased to 40,000 yards, if the number of patterns is doubled; this extra expense amounting to $9,000 at the current prices.

An alternative plan is to increase the number of patterns by about 16 the first year, making a total of 100. This can be accomplished by obtaining from the selling agent its selection of 32 patterns which are considered inferior to the other 68 that are to be run. Three looms then will be operated on each of these 32 patterns for the production of 120-piece sets. The remaining 408 looms normally will produce the 68 more popular patterns in 240-piece sets; the less popular patterns will thus be run in 5,000-yard sets and can be repeated late in the season if the judgment as to their salability proves to have been wrong. The second year the number of patterns can be increased again to perhaps 110 and the run of 20 more of the less popular patterns can be shortened. The decisions as to which patterns shall be run in 120-piece sets will be delayed until the estimate of sales can be made as accurately as possible.

The adoption of the latter plan will lessen the risk of large

loom during this period weaves one loom beam or 1,660 yards; thus, if the mill runs one loom beam of each pattern on 500 looms, it produces 500 different patterns. If, however, it runs 10,000-yard sets, six looms are required for each set, and the number of patterns produced during a season is 84. This is the condition in the Van Roon mill at the present time.

[1] Suggestions are made by the designers of the selling agent. Sample patterns are designed in various color combinations, and, with the approval of the mill, selected patterns are made up in the looms to be used as samples by salesmen and wholesalers.

inventories, since the least popular patterns will be manufactured sparingly. It also will avoid the danger of radically upsetting production and permit the adding of equipment in instalments instead of all in one year. The additional cost of short-run patterns will be prorated to other patterns.

6. LANG CHEMICAL COMPANY—BUDGETS

In order to secure better control of its manufacturing and financial operations, the management of the Lang Chemical Company several years ago installed a budget system drawn up by its chief accountant similar to Form 45.

The figures used in the budget were the best available estimates of the various expenses during the budget year. The first six lines of the budget form gave compilations of the investments in land, buildings, building fixtures, furniture, utensils, machinery, and motor trucks. The following six lines showed statistics used for the distribution of expenses between departments. The next section of the compilation sheet indicated the charges to departments, based upon the statistics at the top. For example, $100,000 was the investment in land. Interest on this figure at 6% was charged to the manufacturing department for the year. The interest charge was divided among the departments according to the investment in land for each. A recapitulation by factors was given in summary form at the bottom. Whenever actual prices during the budget period did not conform to the estimates, the budget figures were changed in order that the monthly charges to the departments, based on the budget, would absorb the actual expenses during the year.

It will be noted that in the Recapitulation at the bottom of Form 45 the total amounts given for rent, light, and so forth, include the amounts distributed to producing departments only; charges to service departments are excluded in a manner to avoid duplication. Thus, the amount for rent in the recapitulation is $75,130; in the form above the amount is $82,500; the difference is the $4,690 in power, $43 in telephone service, and $2,637 in garage. The total of all expenses, in the main form and in the recapitulation, is $140,182.

It had been argued that the estimates should be made sufficiently large so that changed conditions would not necessitate

Budget of Uncontrollable Expenses

Period Beginning July 1, 1922 Computed for One Year

Totals	Item	Redistributed Charges: Power Plant	Building Service	Telephone Service	Laboratories	Chemicals	Print	Box	Administration	Garage
$100,000	Investment in Land	$ 3,000		$ 50	$ 30,000	$10,000	$ 3,000	$ 4,000	$ 34,950	$15,000
700,000	Investment in Buildings	45,000		400	250,000	80,000	23,000	25,000	260,000	16,600
90,000	Investment in Building Fixtures			50	34,000	11,000	3,000	3,950	38,000	
400,000	Investment in Furniture, Utensils and Machinery				150,000	37,000	46,000	15,000	150,000	2,000
30,000	Investment in Motor Trucks									30,000
$1,320,000	Total Investment	$48,000		$500	$464,000	$138,000	$75,000	$47,950	$482,950	$63,600
240,000	Chargeable Area in Square Feet			100	90,000	30,000	8,000	9,900	102,000	
	Per Cent of Total Chargeable Area									
300	Horse Power Installed, Electric		100		120	30	30	10	10	
80	Inside Telephones Installed	1	1		10	5	1	1	60	1
400	Aver. Number of Employees (Exclusive of Office)	4	20	4	200	62	20	10	70	10
$420,000	Average Payroll.	$5,000	$23,000	$2,000	$180,000	$50,000	$49,000	$16,000	$80,000	$15,000
	Expense									
$ 6,000	Interest on Land Investment at 6%	$ 180		$ 3	$ 1,800	$ 600	$ 180	$ 240	$ 2,097	$900
42,000	Interest on Building Investment at 6%	2,700		24	15,000	4,800	1,380	1,500	15,600	996
14,000	Depreciation on Buildings at 2%	900		8	5,000	1,600	460	500	5,200	332
13,000	Taxes on Real Estate	800		7	4,500	1,500	400	493	5,000	300
6,000	Maintenance and Repairs of Buildings	100			2,200	700	200	200	2,500	100
500	Insurance, Fire (Buildings)	10		1	200	50	10	20	200	9
800	Insurance, Occupancy				300	100	30	30	340	
80	Insurance, Spur Track				30	10	2	3	35	
40	Insurance, Sprinkler				15	5			20	
80	Insurance, Elevator				30	10	10	10	20	
$82,500	Total Rent Charged	$ 4,690		$43	$29,075	$9,375	$2,672	$2,996	$31,012	$2,637
600	Maintenance and Repairs of Equipment	600								
3,500	Supplies and Incidentals	500	$3,000							
20,000	Fuel Oil	20,000								
5,000	Salaries, Engineers and Firemen	5,000								
5,000	Salaries, Caretakers		5,000							
5,000	Salaries, Watchmen		5,000							
6,000	Salaries, Elevator Operators		6,000							
6,000	Salaries, Yardmen		6,000							
500	Purchased Power	500								
50	Insurance, Boiler	50								
30	Insurance, Fly-Wheel	30								
3,000	Water	600			1,000	300	100	100	850	50
2,000	Truck Hire from Cartage Dept.		2,000							
30	Special Telephone Charge	10	20							
	Distribution of Power Charges									
	$4,797 Light 15%			7	2,000	600	200	200	1,790	

	9,594 Heat 30%			10	3,000	1,000	300	300	4,000	984
	7,995 Power, Electric 25%		2,000		3,800	700	900	250	345	
	6,396 Power, Steam 20%				5,000	900		400	96	
	3,198 Refrigeration 10%									
$139,210	Total	$31,980	$29,020							
3,198	Less Refrigeration	3,198								
8,000	Less Credits to Building Service, Salvage, Etc.		8,000							
	Total Balance Redistributed	$28,782	$21,020							
	Distribution of Building Service Charges			20	8,000	2,500	700	800	9,000	
$128,012	Total Rent, Light, Heat and Power			$ 80	$51,875	$15,375	$4,872	$5,046	$47,093	$3,671
100	Telephone, Trunk Line Service			100						
1,300	Telephone, Auxiliary Service			1,300						
2,000	Telephone, Excess Service			2,000						
100	Telephone, Moving Expense			100						
2,200	Telephone, Operators' Salaries			2,200						
$133,712	Total Telephone Expense			$5,780						
30	Less Special Telephone Charges			30						
$133,682	Balance			$5,750						
	Distribution of Telephone Charges				400	260	20	20	5,000	50
1,400	Department Water Tax				1,300	100				
1,400	Department Insurance, Fire				500	100	200	50	500	50
4,000	Department Taxes, Personal Property				1,460	300	500	140	1,400	200
$140,482	Grand Total				$55,535	$16,135	$5,592	$5,256	$53,993	$3,971

100 Per Cent		Departmental Per Cents of Burden							
				39.6%	11.5%	4.0%	3.7%	38.4%	2.8%
Sq. Ft. Rate per Month	Totals	Factor	Yearly Sq. Ft. Rate	RECAPITULATION BY FACTORS					
$0.0261	$75,130	Rent	$0.3130	$29,075	$9,375	$2,672	$2,996	$31,012	*
.0016	4,790	Light	.0200	2,000	600	200	200	1,790	†
.0030	8,600	Heat	.0358	3,000	1,000	300	300	4,000	
.0073	21,000	Building Service	.0875	8,000	2,500	700	800	9,000	
$0.0380	$109,520	Total Rent, Light, Heat and Building Service	$0.4563	$42,075	$13,475	$3,872	$4,296	$45,802	
	4,000	Taxes		1,460	300	500	140	1,400	$ 200
	1,400	Insurance		500	100	200	50	500	50
		Depreciation							
	3,800	Water		2,300	400	100	100	850	50
	6,396	Steam		5,000	900		400	96	
	5,995	Power, Electric	29.975	3,800	700	900	250	345	
		Refrigeration (Charged Monthly on Basis of Consumption)							
	3,621	Garage Rent and Heat							3,621
	5,750	Telephone and Telegraph		400	260	20	20	5,000	50
	$140,482	Total		$55,535	$16,135	$5,592	$5,256	$53,993	$3,971

*Garage rent below. †Garage heat below.

Form 45: Budget System Form

altering the budget figures. Such a procedure, however, probably would result in an overabsorption which would have to be charged off at the end of the year and that would be as objectionable as the underabsorption or overabsorption which resulted from the existing budget plan. Although the budget in use required much time and expense for its compilation, according to several of the executives it served no essential purpose, because equitable charges to departments could be derived by averaging the charges of previous years. Such charges, however, would be more in the nature of normal costs than actual costs, or estimates of actual costs, and manufactured goods should be charged as far as possible with the actual expenses incurred for them. The existing budget, furthermore, did not provide sufficient control over the manufacturing processes.

Should the Lang Chemical Company have continued to use its budget system?

7. THE IMPERIAL PAPER COMPANY—INCLUSION OF MONTHLY COSTS IN BUDGET

The Imperial Paper Company, with its office in a central New England city, and several mills at other points, manufactures and sells a variety of high-grade office stationery. The entire business is controlled by the use of a budget which covers all phases of manufacturing, marketing, and administration.

In October of each year the statistical and accounting department made a careful survey of the company's business for several previous years. This survey studied the periods of peaks and depressions in the company's sales as well as general business cyclical conditions. From this survey a preliminary schedule was drawn up to show the maximum sales which could be secured during the coming year. These figures were arrived at previous to any consultation with the sales department and were based upon the statistical information collected by the company.

The schedule was then referred to the sales manager for comparison with his estimates of sales during the year in question. The two estimates usually agreed closely. Minor changes were adjusted at a conference of the two departments. When a wide divergence occurred, the case was laid before a meeting of all

the officials of the company, and a definite figure decided upon.

After the sales manager accepted the preliminary budget, a conference of the company's wholesale distributers was called. All products were distributed through a selected group of wholesalers who were independent of the Imperial Paper Company, but who cooperated to the fullest extent with the company. Each wholesaler sent a representative to the conference, and the budget was placed before these representatives. Necessary modifications then were made if the sales estimate seemed too high or too low. At the termination of the conference the sales manager wrote a letter to each wholesale distributer informing him of the exact amount of product in tons which he would be expected to purchase and distribute during the year. The amounts named in all cases were accepted by the wholesalers.

The vice-president in charge of production then was given an estimate of the total amount of materials required during the year to fulfil the commitments made to the wholesalers. From the mill managers the vice-president secured detailed schedules of the estimated expenses which would be necessary to enable the mills to produce the tonnage specified. The schedule submitted by the mill managers contained all the usual operating expenses of the mill including the costs of repairs and replacements.

Raw materials required were ascertained from two sources: the woodland manager estimated the cost of delivering the proper amount of cut wood to the mills, and the purchasing agent in the central office submitted a similar schedule of the total estimated purchases of other raw materials.

The officials in charge of the various administrative departments prepared schedules showing the expected expenditures for each department.

All these estimates were examined by the head of the statistical and accounting department, and a final budget was drawn up. This budget was arranged so that it showed for each month in the year the receipts expected from three sources: Sales, Dividends on Stock Owned, and Miscellaneous Income. The sales were reckoned on the total tonnage to be sold during the year figured at the prices in effect when the budget was made.

Below the expected income were shown the amounts to be expended each month on the following accounts: merchandising,

improvements, advertising, salaries, production expense, administrative expense, insurance, interest on notes, mortgages, dividends, taxes, sinking fund, mill expenses, wood department, and miscellaneous. By deducting the total of these expenditures from the total income expected, the officials were able to determine the profit to be made each month.

The completed budget was submitted to the board of directors for approval or alteration. After acceptance by the board, copies were submitted to the heads of each department who maintained an absolute check month by month on their actual performance in comparison with the estimates. The treasurer knew from the budget the exact sum necessary and the probable receipts for each month, and the financial policies for the company were based upon that knowledge.

The books of the company were closed each month, and the final figures were made available to the statistical and accounting department before the tenth day of the following month. The results were tabulated in columns provided on the budget sheet to show the actual figures in relation to the budget figures. Any appreciable differences were checked up immediately and a complete statement submitted to the officials of the company for their action. During the month of January, 1923, for example, it was found that although the tonnage shipped to wholesalers amounted to approximately the 6,000 tons which were anticipated, the profit for the month was 10% below the figure called for by the budget. Examination showed that the actual mill expense figures exceeded the estimate by this amount. The detailed report from the vice-president in charge of production revealed the fact that this condition had been caused by an increase in wages of the mill workmen.

The sales manager was notified of this condition, and an upward revision was made in the price list to compensate fully for the increased cost. The new prices were made effective within one week after the books were closed for the month of January.

The Imperial Paper Company considers that this budget is a satisfactory method of keeping before the officials all the information which is required for the efficient management of the business, and that it acts also to keep each official keenly interested in the performance of the group under his supervision. The cost of collecting and preparing the necessary data is included in standard office expense, and is considered amply justi-

fied by the detailed control of operations which the budget makes possible.

8. MEAT PACKING INDUSTRY—RELATION OF COST ACCOUNTING TO BUYING AND SELLING OPERATIONS

The Report of the Federal Trade Commission [1] on the meat packing industry criticizes severely cost accounting methods used by the large packers. The following is an excerpt from this part of the report.[2]

At the instance of the President's meat committee and of the United States Food Administration, the Commission made a survey of the possibility of introducing a uniform accounting procedure for the great packers. It was found that in order to ascertain accurate costs and profits, not only on specific products, but on the business as a whole, sweeping revisions in the accounting methods now followed by the several companies would have to be adopted.

Accuracy of departmental or specific product costs turns upon the introduction of a sound cost system whereby the exact cost of the live animal can be allocated to the several departments handling different products derived from that animal, thus charging each product with a share of the original cost, instead of charging the original cost as at present to the carcass meat department, and crediting by-products thrown off from the animal, on the basis of ill-defined "market values." If transfers between departments, and the pricing of inventories can be reduced to a cost basis, the problem of accurate profit finding is largely solved.

The following statements appear in the same part of the report.[3]

To get at the profit on beef it is necessary to secure the cost of that portion (about 55% of the live animal weight) of the steer which goes into carcass meat. Not until a cost system is evolved whereby there is an initial slaughtering department which kills the animal and transfers the various parts to other departments (such as dressed beef, hides, oleo, and so forth) in such a fashion that each department absorbs a proper share of the total live and killing cost, each bearing its proportion of waste and shrinkage, will the packers be enabled to announce with any authority their costs and profits per pound of beef produced.

The departmental cost accounting theory currently followed by the packers is built on the assumption that the carcass meat of the steer is the sole main product and all material thrown off is so much by-product credited to beef on the basis of the prevailing market price, the beef department thus carrying the initial live and killing cost of the whole

[1] Part V, "Profits of the Packers." [2] Ibid., pages 13 and 14. [3] Ibid., page 77.

animal. It is obvious that the live steer is not killed for its meat alone, but also for its hide and fats; as well, in a lesser degree for its other products. The leather industry is one of the oldest and most important, not only in the country, but in the world, and the same can be said for cattle fats. Market conditions covering these so-called by-products are important considerations in the mind of the packers' live-stock buyer when he sets the price he is willing to pay per pound for the live animal. To a lesser degree the value of other products such as bones, casings, offal, and so forth, have their place in fixing this price. The cost of beef cannot, accordingly, be assumed to be the cost of the live animal, credited with the returns from all material except carcass meat.

The following is an excerpt from "Joint Cost in the Packing Industry," an article in the *Journal of Political Economy*,[1] by George E. Putnam of the commercial research department, Swift and Company.

. . . . Under the circumstances there is only one method that the packer can follow if he is to know in what operations it is worth his while to engage. In the first place, he must deduct the value of all by-products from the total live and killing cost of the animals slaughtered in order to arrive at a cost figure for his main product. If any of his by-products are advanced to a further stage of processing, the net market value of the by-products must be taken as the initial cost in the undertaking. Such procedure would necessarily follow from the fact that the packer has one of two alternatives where his raw by-products are concerned: either he can sell them to someone in the outside trade at the current market prices, or he himself can assume the cost and risk of subjecting them to further processing.

For accounting purposes, the large packing plant is divided into a number of departments, each dealing with a specific product or a group of related products. The operating departments are to be distinguished from the service departments because the latter sell few products to the outside world. As a rule, they merely furnish the operating departments with supplies and services.

Each department records its own purchases, sales, inventories, expenses, and transfers to and from other departments, so that the net result of each operating department in terms of profit or loss may be readily ascertained for a given period. Not all of the service departments will show a net balance, because in some cases their services are rendered to the operating departments at cost.

The reason for the maintenance of these departments is to be found in the varied manufacturing processes and functions which characterize the packing industry. As has already been indicated, the industry is really a collection of industries, a whole succession of industries, each one of which is expected to stand on its own feet.

[1] Volume XXIX, No. 4, April, 1921.

Suppose, for instance, that animal-fat products (a by-product of beef) are transferred to the soap department. To the beef department the transfer is obviously a sale; to the soap department it is a purchase of raw material. Each department pays for all it gets and is paid for all that it gives. Since the soap department represents a distinct business in competition with firms engaged only in soap-making, the soap department of a packing plant is operated along similar lines. All material transferred to this department is valued at the current market price, the price at which competing soap concerns obtain their raw material.

The departmentization of accounts also provides the packer with statistics on operating costs which enable him to know in what form a given product should be marketed, whether it should be sold in its present state or whether it should be processed further. Bacon, for instance, may be sold either in the cured or smoked state. Hams may be sold as fresh, cured, boiled, or smoked product. The packer who conducts both an oleomargarine and lard compound business has the choice of transferring oleo oil to the oleomargarine factory or of selling it in the open market. The final decision in all such cases will depend entirely upon the cost of processing and the market that exists for the product in each of its various stages. If the packer is to be able to adjust his business quickly and intelligently to the varying demands of the market, he must have at hand complete statistics on the operating cost of each department.

Under the departmental system of accounts, the method of arriving at the dressed cost of beef is as follows: To the cost of the live animal is added the current expense of handling the animal through the packing-house and branch-house organization. This gives total cost. From this total is deducted the value of the hides, according to weight and grade, figured at the actual market value of cured hides, with an allowance for shrinkage in curing and for expense of curing. There is also deducted the value of the fat and other by-products, figured at their full market value at the time the animals are killed, less the cost of processing. Deducting these figures from the total cost (live cost plus the expense of handling) gives the cost of the dressed beef, which, divided by the weight of the beef, gives the cost per pound. This cost compared with the selling price of the beef from a particular lot, informs the packer whether he is making or losing money day by day and week by week. It is the guiding factor in his buying operations.

The following are excerpts from "Unit Costs as a Guiding Factor in Buying Operations," an article in the *Journal of Political Economy*,[1] by George E. Putnam, commercial research department, Swift and Company.

There is a prevalent notion, chiefly among accountants and business

[1] Volume XXIX, No. 8, October, 1921.

men, that the primary function of a cost-accounting system, say in a manufacturing establishment, is to enable the manufacturer to arrive intelligently at an asking price for his products. According to this notion, which is entertained also by a few economists, the manufacturer determines his minimum asking price merely by adding together the cost of his raw material and the expenses incurred in converting the raw material into a finished product. The better his system of cost accounts, the greater the likelihood that his business will be conducted along profitable lines because unit costs are, or should be, the guiding factor in his selling operations.

In a recent number of this Journal, the writer expressed an entirely different point of view as to the function of cost accounting in the meat-packing industry, and stated, without attempting to develop the point, that "It (the packer's cost-accounting system) is the guiding factor in his buying operations." [1] This statement aroused a good deal of criticism from the accounting fraternity, and the question was asked, "Is not the packer's cost-accounting system a guiding factor in his selling operations?"

The purpose of the present article is to show that the packer's cost-accounting system performs one of its chief functions in indicating the maximum price that can profitably be paid for live stock rather than in determining the minimum asking price at which meat and by-products will be offered; and, incidentally, that a system of cost accounts performs essentially the same function in many other industries.

It is unquestionably true that unit costs are a factor in the packer's selling operations. The cost of every product is carefully determined and, in most cases, the sales manager who is responsible for the disposition of a particular product knows its manufacturing and distributing cost. But there is no necessary relation between this cost and the price finally paid by the retailer. In a deficiency market or during a period of rapidly rising prices, the price paid by the retailer may be above cost, while in periods of falling prices or in markets where the consumptive demand has been overestimated, the price may be substantially below. About the only real service which a cost figure renders in this connection is that its possession has a wholesome effect upon the selling agencies—it urges them to put forth greater effort in pushing their products, especially when losses are imminent, with the result that losses for the time being may be prevented or at any rate considerably reduced.

There are at least two important reasons why a packer cannot expect to market his products on a strictly cost basis. In the first place, the greater portion of his products consists of perishable meats which must be moved promptly into consumptive channels. Fresh beef, for instance, must be in the hands of the retailer within two weeks at most after the animals are killed; otherwise it will deteriorate in quality and the trade will discriminate against it. The case would

[1] "Joint Cost in the Packing Industry," *Journal of Political Economy*, XXIX, No. 4 (April, 1921), 297.

be entirely different if the packer could freeze and hold beef carcasses from one season to another, thereby avoiding forced sales. But the consuming public insists on having fresh chilled beef, with the result that only about 5% of the beef dressed in packing plants is put through the freezing process. The quantity of beef that is cured and canned is even smaller.

In the second place, the demand for meat is exceedingly variable. While the total consumptive demand depends primarily upon the relation of meat prices to the prices of other kinds of food, it is affected also by the Lenten Season, Jewish holidays, changes in the weather, and general industrial conditions. Some of these factors can be anticipated with reasonable accuracy by the packer on the basis of his past dealings. But when it comes to anticipating the fluctuations in the total demand for meat in specific communities, fluctuations in the particular kinds of meat required, and the volume of meat products that will be supplied in particular sections of the country by competing concerns, it will readily be seen how impossible it would be for any packer, even during a period of normal business conditions, to market his products on a strictly cost basis. He must be governed in his selling operations by market conditions essentially, rather than by cost considerations.

The effect which price changes have on the general consumptive demand is best shown by a comparison of cattle receipts and wholesale beef prices. The receipts of cattle at the primary markets are subject to wide seasonal fluctuation. During the fall months—after the grass season is over and the corn crop has been harvested—receipts are greater than at any other time of the year, while in the period from February to June inclusive, receipts are normally small. Since the supply of beef in the hands of the packer is dependent on the number of beef cattle shipped to market, and since only a small quantity of beef can be stored, it follows that more beef must be consumed in the fall than in the spring; also, that the price must be low during the period of large receipts and high during the period of small receipts in order to adjust the consumptive demand to the existing supply.

In estimating the part which the packer's cost-account system plays in this adjustment process, it is to be noted first of all that the demand for live stock is derived from the demand for live-stock products, and that the price which the packer can afford to bid for live animals obviously depends upon the price that he can get for meat and by-products less his expense of manufacture and distribution. When retailers, prompted by the urgent demands of their customers, are willing to pay higher prices for meats, the packer tries to increase the volume of his business in order to realize as large a profit as possible from his operations. And since he can increase the volume of his business only by buying a larger number of live animals in the open market, competition with other buyers forces up the price of live stock.

Likewise, when changed conditions of demand or of supply cause

a decline in the wholesale price of meat, the packer may be compelled to reduce the volume of his purchases or operate at a loss. In any case, it is obvious that he cannot afford to bid at the same rate for live stock as before; and since the majority of other packers are confronted by the same conditions, live-stock prices fall. Not infrequently, however, a considerable period of time elapses before the balance between the price of live stock and the price of live-stock products is restored. Naturally, a packer hesitates to reduce abruptly his volume of business, and thereby increase his unit cost of operation, especially when there is any likelihood that some competitor will be in a position to absorb a part of his regular trade. His plants must be kept in operation, and the requirements of his regular trade must be supplied. Furthermore, it is always necessary to compete with concerns which, on account of faulty cost-finding methods, conduct their buying operation less intelligently. For one reason or another, on a falling market, a packer may be forced for weeks at a time to bid more for live stock than the market price of his products less the expenses of operation.

Another point to be noted in this connection is that unit costs vary according to the quality of live stock purchased. In the case of cattle, for instance, the weight of a dressed carcass varies all the way from 45 to 65% of the live weight. Other things being equal, the greater the percentage of dressed weight that can be obtained from a steer, the lower will be the cost per pound of beef.

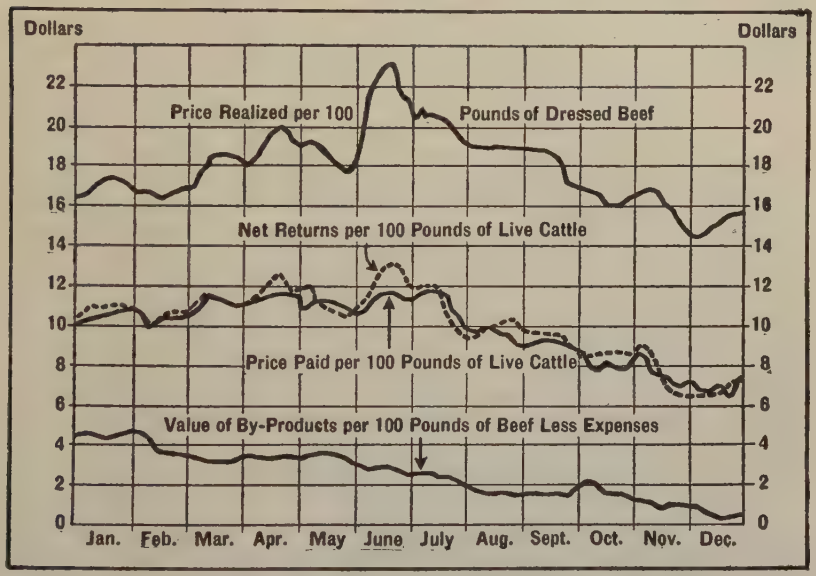
It is manifestly impossible for a live-stock buyer to know in advance the actual cost of the meat that will be obtained from a given purchase. But an experienced buyer is an expert in estimating dressing percentages; and, knowing from current operations the dressed cost of similar lots of live stock, he is able to determine with a remarkable degree of accuracy the dressed cost that will result from a given purchase price. Knowing also how live-stock products of a definite quality are selling in the various wholesale markets, he tries to buy live animals at a price that will yield a profit when they are disposed of in the form of meat and by-products. The buyer subsequently learns from the accounting department whether on the basis of existing values the purchase was successfully made.

Thus the calculation of dressed-cost figures serves not only as a guide in determining the maximum price that can profitably be offered for live stock, and the quantity that should be purchased, but also as a check on the efficiency of the live-stock buyer. The result of this unit cost service is that live-stock prices follow fairly closely in line with the prices obtained for live-stock products, and the margin between buying and selling price is normally sufficient to cover the expenses of operation and yield a return on invested capital.

Form 46 shows, with some qualifications to be dealt with later, the weekly financial results for the year 1920 of the cattle operations of the company with which the writer is connected.

As a means of comparing live-stock prices with the prices of live-stock products so as to show the weekly margins of profit or loss,

the sale price [1] actually realized per hundredweight of dressed beef has been reduced to a live basis by taking into account the dressing percentage of each lot of cattle purchased. To these figures has been added the value of hides and other by-products per hundredweight of beef (reduced to a live basis in the same manner) at the time of slaughter, less all manufacturing and distributing expenses except interest. These combined results are indicated on the chart by the broken line which corresponds closely to the solid line showing the prices paid for live cattle. When the broken line is above the solid



Form 46: Weekly Results of the Cattle Operations at Swift & Company, 1920

line, the difference between the two lines represents the margin of profit for that week; where it is below, it represents a loss.

It should not be inferred that the weekly margin of profit or loss, as revealed in the chart, is available at the end of each week. Before the margin on a particular week's operations can be determined, all the beef dressed during that week must be sold, and beef cannot be sold immediately after the animals have been slaughtered. It must be chilled for 36-48 hours before it can be shipped, and it may be in transit several days before it reaches the packer's branch house where it is sold to the retailer. Normally a period of two weeks or more

[1] The price of dressed beef, as shown for any one week in the chart, is the average of prices finally realized for all beef dressed during that particular week, irrespective of the time when the beef was actually sold. The price paid for live cattle and the value of by-products (less expenses) are an average of the prices and values, respectively, obtaining in the weeks as shown.

must elapse before the margin on a particular week's operations can be finally determined.

Attention should also be called to the fact that, since the weekly margins of profit and loss are found by deducting the cost of live animals plus operating expenses from the proceeds of beef sales plus the net value of by-products at the time of slaughter, they cannot be regarded as profits or losses actually realized. They are calculated before by-products have been processed and sold, and therefore may have little bearing on the profit and loss statement covering the year's operations.

There is good reason for combining unrealized by-product values with prices actually realized for beef, in arriving at the profit and loss margin, even though this procedure appears to be inconsistent. In the first place, by-products are of much less importance than beef in cattle operations and, under ordinary conditions, they are not likely to appreciate or depreciate materially in value from day to day or from month to month as does beef. The fundamental reason, however, is that it would be inexpedient to wait until all by-products had been disposed of before calculating the margin of profit, because by-products move slowly into trade channels, much more slowly than beef. It requires two weeks, for instance, to convert edible fats into oleo oil, not to mention the time required to sell the finished product. Hides, the most important by-product of beef, cannot be cured in less than 30 days, and it may be two or three months before a sufficient number of cured hides of a particular grade has been accumulated to meet the requirements of a buyer. Under these conditions, if the cost figures are to be of any use either in buying cattle or in selling beef, the packer is virtually compelled to calculate his current profit and loss margins on the basis of unrealized by-product values—or, what amounts to the same thing, to calculate his dressed-beef costs on the basis of existing by-product values—and assume the risk of fluctuation in those values.

This method of procedure proved to be unfortunate for the packer during the year 1920, on account of the tremendous decline in by-product values. At the beginning of the year, the net value of the by-products from a 1,000-pound steer amounted to about $28; by the end of the year the same products had a net value of only $7, or less than sufficient to cover the expenses of handling the animal through the packing-house and branch-house organization. The steady fall in the value of these raw products during the period they were in the process of cure or manufacture made it wholly impossible to realize the tentative margins of profit shown in the chart above. As a matter of fact, the average loss per head on cattle operations for the calendar year was 22 cents, and the total loss, $495,125.

One other matter growing out of the fall in by-product values remains to be noted. Reference to the chart shows clearly that with the fall in by-product values, the spread between the price of beef and live cattle per 100 pounds became substantially wider. At the

beginning of the year the price of beef per pound was about 160% of the live price, while at the end of the year the percentage had increased to more than 200. This change in the relationship of cattle to beef prices at once suggests the question: What effect did the fall in by-product values have upon the wholesale price of beef? Did it result in making beef prices higher than they would have been otherwise, or did it have no effect of any consequence?

It would be contended by some of those to whom this article is addressed that the fall in by-product values automatically and immediately raised beef prices. Their argument would go somewhat as follows: The prices asked for beef and by-products together must be high enough to cover the cost of live cattle, plus the expenses of operation. If the value of by-products falls, the cost of the beef rises accordingly, and the packer must get more for his beef in order to come out even.

The fallacies in this argument are at once apparent. If it were possible to raise the price of a perishable product like beef, simply because by-products had fallen in value, and at the same time move the whole supply into consumptive channels, it would likewise be possible to prevent the value of by-products from falling below cost. The main fallacy, of course, lies in the assumption that the price of live-stock products depends upon live-stock prices. The causal relationship is just the reverse. A decline of $1 in the value of the hides and other by-products per 100 pounds of live cattle will cause a corresponding decline in the price of live cattle—assuming that operating cost and the demand for beef remain unchanged—and widen the spread between cattle and beef prices. Likewise, a rise in the values of by-products will cause an increase in the price of live cattle by a corresponding amount, and narrow the spread between cattle and dressed-beef prices.

Obviously, it is the price of cattle, rather than the price of beef, that is immediately affected by a fall in by-product values. The price of beef could not rise in this case except through a diminution in the number of cattle shipped to market, and since cattle already produced must be sold whether the price is high or low, it follows that a slight fall in cattle prices could have no appreciable effect, for the time being, in diminishing the supply of beef or in raising beef prices.

There is no denying the fact, however, that a steady decline in by-product values will sooner or later affect the price of beef by reducing the supply. Declining cattle prices will ultimately curtail cattle production; and even before there has been an actual reduction in the number of cattle produced, many of the cattle being prepared for shipment will be marketed before they are properly finished. In either case the supply of beef will be diminished and, other things being equal, beef prices will be higher than they would have been had not the value of by-products fallen.[1]

[1] It is impossible to determine just how long a period of time would be required

A somewhat similar conclusion, in so far as it concerns the long-time effect upon beef prices, would be reached by those who contend that unit costs are a guiding factor in selling operations. But they would reach this conclusion more by accident than through a process of careful reasoning. In contending, as they do, that unit costs determine the manufacturer's minimum asking price, they completely overlook the subtle but fundamental fact that the price paid by an intelligent enterpriser for raw material is dependent first of all upon his unit costs of operation and the price at which he thinks he can sell his finished products; therefore, the guiding service which unit costs may appear to render in enabling the manufacturer to determine or to realize his minimum asking price is merely one of repetition—it is a service which was previously rendered in the buying operation. * * * The fundamental point for which the writer contends is that in the case of both perishable and non-perishable products, unit costs, although appearing to guide the seller, perform their real guiding function at the time goods are purchased for resale. Any service which they subsequently render is in the nature of reminding the seller of the price at which he originally expected to sell with the result that he may put forth greater sales effort in trying to realize this price.

It does not follow, however, that sellers will realize the prices they anticipate—witness the losses occasioned by the recent price decline—even though the product in question is non-perishable. For, after all, unit costs do not determine prices. While it happens to be true, according to current economic philosophy, that the price of a finished product tends to be equal to marginal cost—i. e., the cost of the raw material entering into the product plus the unit costs of operation in the most inefficient firms—the real chain of causation is not from the price of the raw material through cost of manufacture and distribution to final consumers' price. It is exactly the reverse. It is human desire that leads to human effort, demand that leads to supply, and therefore present and prospective consumers' prices that lead to producers' prices.

9. CROCKER AND LANG VENEER COMPANY—COSTS AND SELLING PRICE OF A BY-PRODUCT

The management of the Crocker and Lang Veneer Company wishes to increase its sales of veneer. As the company finds only about 30% of its logs satisfactory for veneer,[1] the remainder is

to bring about this result. The question cannot be answered by a study of live-stock receipts and prices in the primary market because (1) not all of the receipts are purchased by packers, and (2) there are wide variations in the demand for beef, in the live weight of cattle slaughtered and in dressed yields. Under these circumstances, the statistics of receipts do not afford a dependable barometer of the forthcoming beef supply or of beef prices.

[1] Veneer is a term applied to thin leaves or layers of wood. Generally veneer is made of valuable wood which is laid over a core of inferior wood. It is also

made into lumber. At present three-fourths the cost of the logs is charged to veneer and one-fourth to the lumber by-product. By this method of charging it has been found that a good profit is made on the manufacture of veneer and at the same time a small profit on the manufacture of lumber. The firm is considering changing this method of charging raw material to its products in order that the cost of the manufactured veneer may be reduced and a consequent cut in price be made.

About 50% of the material used by the veneer plant is yellow birch and hard maple logs obtained from Vermont. Although logs suitable for lumber can be obtained by the sawmills for $15 to $20 a thousand feet, the cost of logs suitable for veneer is about $50 per thousand feet. This high cost of the veneer logs is due to the fact that men are sent out from the factory in Boston to travel through the high-grade maple and birch sections of western Vermont, picking out logs, either in the woods or at the mills, which are believed suitable for veneer. Similar methods are employed in selecting walnut and yellow poplar logs. The cost of mahogany and foreign woods which are obtained through brokers in London who are acquainted with the needs of veneer plants occasionally runs over $200 a thousand.

One rate which has been considered is to charge two-thirds of the raw material price to the veneer and one-third to the lumber. It has been estimated that by so doing a slight loss would be taken on the lumber, but it should be possible to reduce the price on veneer to such an extent as to undersell competitors and increase sales substantially.

It has also been suggested that the raw material be charged to both the veneer and the lumber at its actual cost. In this case lumber would bear 70% of the raw material cost and veneer the

used in ply wood made of several pieces of veneer in which the grains run in different directions so that it is impossible to split it. In this way strong but light pieces may be built up. It is cut either with thin saws or with knives from the logs after they have been steamed for several hours in order to soften them.

The company saws each log into as large a quantity of veneer as possible. The veneer from each log is kept together throughout the processes of drying, flattening, and shipping. The salesmen go out with samples from each log which are selected so as to give the best idea of the color and figure. As all veneer from one log will react similarly to the same kind of varnish and polishing and will have a similar figure on it, the users of high-grade veneers always desire to obtain the product from one lot for use in one room or on one piece of furniture. It is sold by surface area; the prices are set according to the species and quality of log from which the veneer is obtained and according to the beauty of the figure.

remaining 30%. This method would result in a large increase in the profit on veneer and a loss on the lumber, but there would be no guesswork as to what should be charged for the material.

Another plan which has been discussed is to allocate the cost of the raw material to the product according to the amount for which the product is sold. Thus, if out of $60 worth of logs there was made $150 worth of veneer and $30 worth of lumber, the veneer would stand $50 of the expense and the lumber $10.

What policy should the Crocker and Lang Veneer Company pursue in charging the cost of raw material to its veneer and lumber?

10. SCHILLER CHOCOLATE AND COCOA COMPANY—JOINT COSTS IN RELATION TO VARYING MARKET CONDITIONS

The treatment of two products emerging from the same process is shown in the following description of the situation in the chocolate and cocoa industry, taken from the *Official Publications* of the National Association of Cost Accountants.[1]

The problem of by-product costs arises in ascertaining the respective costs of butter and powder [2] at the press. It may be of interest to note that it is solved in this industry by applying the market value or sale price to the main product, butter; and the balance of the cost of manufacture to the by-product, powder.

The explanation of this method of by-product accounting lies in the small domestic demand for cocoa and high protective tariffs abroad which practically close the European markets to the overproduction of American cocoa, in the competition of foreign cocoa-butter and in the close association of the chocolate and confectionery industries.

Our large per capita consumption of candies demands a large production of butter with a corresponding production of powder which is greater than the country will absorb at a price which will return a profit except to the large manufacturer with an established name and trade.

In Europe the condition is reversed because the manufacturer finds a ready market for his powder at a profitable price, and the industry is encouraged by high tariffs which effectually shut out the competition of American overproduction. Confectionery not being so generally in demand, the butter commands a relatively lower price without finding

[1] Volume III, No. 20, July 15, 1922.

[2] The processes prior to this point, which give rise to these two products, butter and powder, are described in Problem 24, Ch. VI, "Accounting in the Chocolate and Cocoa Industry."

a home market for the entire product. The surplus is shipped to America and except during the war it has practically established the market price here.

The American candy manufacturer takes the butter into his costs at its purchase price. The chocolate manufacturer who is also a confectioner, follows the same practice in order to meet competitive costs because he often finds the European butter selling below his cost of manufacture. The manufacturer of chocolate coverings for candies is compelled to adopt the practice, so it becomes general. As the market quotations vary from day to day, the average for the month is the price at which butter is charged into the mixture. A standard cost for butter prevents the fluctuations in cocoa costs which attend the use of market price for the butter. If one were inclined to criticize this method of accounting for a by-product, it might be justified in principle by the relative sale values of the two articles. The butter commands the higher price and therefore should bear the larger part of the cost.

It would be impracticable to apportion the total cost of manufacture upon the basis of the respective volumes of the products because of their gross disproportion to selling prices in both high-priced and low-priced markets. Under such a procedure, both butter and powder would have the same cost per pound, which would be the cost of liquor plus the cost of pressing. Such a method of costing at the recent extremes of high and low prices would have given the following results:

Item	High-Priced Market Cents	Low-Priced Market Cents
Cost of beans, per pound	14.0	7.5
Cost of liquor, per pound	19.4	10.24
Cost of pressing, per pound	.5	.40
Cost of butter and of powder at the press, per pound	19.9	10.64
Add cost of pulverizing the powder, packing, containers, and so forth	1.6	1.30
Total factory cost of powder	21.5	11.94
Selling price	14.0	3.00
Loss on powder, not including selling and general expenses	7.5	8.94
Cost of butter at press, as above	19.9	10.64
Selling price	39.0	27.00
Gain on butter	19.1	16.36

It is admitted that the practice of allowing the powder to carry only the excess of manufacturing cost over the market value gives costs to both powder and butter which are equally out of proportion to their market values. With the prices in the foregoing comparison in effect, the respective costs of the powder were obtained as follows:

Item	High-Priced Market	Low-Priced Market
Cost of products of the press, per pound as in previous table	$ 0.199	$ 0.1064
From a press holding 271 pounds of liquor, the combined values of the butter and powder were	$53.93	$28.83
There were produced 113 pounds of butter—		
at market price, 39 cents per pound	44.07	
at market price, 27 cents per pound		30.51
Leaving as the value of 158 pounds of powder	$ 9.86	
Profit to be offset against subsequent cost of processing 158 pounds of powder		$ 1.88
Cost of pulverizing, packing, and so forth	2.51	2.05
Factory cost of 158 pounds of powder	$12.37	$ 0.17
Factory cost of powder, per pound	$ 0.0783	
Selling price, per pound	0.1400	0.0300
Profit (including selling and general expenses)	$ 0.0617	$ 0.0300

Some manufacturers have worked out a ratio of the market price of butter to that of cocoa beans over a period of years and take up the butter at that ratio to their beans cost. This is just another method of applying the same principle. It has the advantage of yielding uniform costs for both products and of keeping the value of butter below that of the liquor when the butter market may be exceptionally high with respect to the price of beans. But it shows a profit on powder only to the manufacturer whose trade name enables him to market his product at a premium. Other manufacturers must offset their loss on powder against their profits on chocolate, which has the same effect as charging the butter into the chocolate mixture at the cost of the liquor at the press less the sale value of the powder, just the reverse of the existing practice.

Either of these two methods, which are the same in principle, are suitable to those industries the main product of which is cocoa-powder. But on the part of producers of cocoa-butter and of chocolate and chocolate products, the practice of taking up the butter at market price and leaving a balance of manufacturing cost to be carried by a by-product for which there is a precarious market is highly specula-

tive. They should adopt the opposite course of crediting the powder at the sale price (or the current market price in the case of makers who have an established trade) and loading the balance of the manufacturing cost on the butter. The small manufacturer would even be justified in charging the entire cost to the butter, the powder carrying only the cost of the processes through which it passes after leaving the press.

The Schiller Company has developed a considerable market, both in high-grade chocolate and cocoa, and wishes to apportion costs to the two products on the fairest possible basis. Upon the information given above, how would you recommend that this be done?

11. THE BOLTEN MILLS—DECISION AS TO WHETHER TO MANUFACTURE A NEW STYLE OF CLOTH

The treasurer of the Bolten Mills has received information from his selling agents in New York that there is a good market for a twilled cloth used by corset makers. Since the mill is operating on styles which are bringing a narrow margin of profit, he has decided to investigate the possibilities of producing the new cloth in the mill.

In order to estimate costs of the new style of cloth, the accounting department has compared it with the material now being manufactured, which is most similar in construction and weaving qualities. The cost data as presented to the treasurer are shown on the two cost cards on page 622.

Costs on these cards are divided into three divisions: manufacturing, selling, and cotton. Manufacturing costs are subdivided into four operations, each of which has been reduced to a pound basis. Each figure is built up from the direct labor cost to which indirect labor is applied at a standard rate; burden is applied at a standard percentage to the total labor cost. The yarn costs of styles of cloth vary according to the count of yarn and the number of threads to the inch of warp and filling. Dressing and drawing-in costs apply only to the warp threads.

The chief difference in the cost of the two cloths lies in the piece-rate paid for weaving. This rate is determined in the production department on a basis of the number of looms which an operative can tend, the number of looms to a loom fixer, and the rate of speed at which the loom can be run on the style of

Style Number 316 Width 38½ Inches		Weight 5.00 Yards per Pound Cost, Cents per Pound
YARNS	Warp 28 55.5% × 10.91 cents Filling 30 44.5% × 11.45 cents Total yarn cost	Pound cost of yarns 6.06 5.10 11.16
DRESSING AND DRAWING IN	Warp 55.5% × 2.16 cents per pound	1.20
WEAVING	Cut price 24c ÷ 60 (yds. per cut) = .4c + 68.69% = .6748c (for indirect labor) + 69.12% (overhead) = 1.1412c per yd. × 5.00 wt.	5.71
CLOTH ROOM AND PACKING	Per yard .189c × 5.00 weight	.95
	Total manufacturing cost	19.02
SELLING EXPENSE	3% of 50 cents per pound (estimated selling price)	1.50
	Total cost without cotton	20.52
COTTON	22 cents ÷ 82% (18% est. allowance for waste)	26.83
	Total cost per pound	47.35
	47.35 ÷ 5.00 = 9.47 cents per yard.	

Style Number—New Width 36½ Inches		Weight 3.85 Yards per Pound Cost, Cents per Pound
YARNS	Warp 28 59.8% × 10.91 cents Filling 38 40.2% × 12.95 cents	Pound cost of yarns 6.52 5.21
DRESSING AND DRAWING IN	Warp 59.8% × 2.16 cents per pound	1.29
WEAVING	Cut price 65.5 cents + 68.69% (Ind. labor) = 110.5c + 69.12% (Overhead) = 186.9c ÷ 60 yards = 3.15 cents per yard × 3.85 weight	11.99
CLOTH ROOM AND PACKING	Per yard .189 cents × 3.85 weight	.73
	Total manufacturing cost	25.74
SELLING EXPENSE	3% of 65 cents (estimated selling price)	1.95
	Total cost without cotton	27.69
COTTON	22 cents ÷ 82% (18% waste allowance) cost per pound	26.83
	Total cost per pound	54.52
	54.52 ÷ 3.85 = 14.16 cents per yard.	

cloth. Each loom operative may tend from 15 to 30 looms; loom fixers who adjust the looms have charge of 100 to 150 looms. The piece-rate paid to loom operatives is designed to pay a normal wage at the rate of production of the looms tended. If an

operative can tend 30 looms, the piece-rate per cut produced (60 yards) is lower than if he could tend only 20 looms.

The cloth room and packing costs are reduced to a yardage basis, which includes a day-rate paid to inspectors, finishers, and shipping personnel, as well as overhead. Since the selling agents are paid a commission on sales, the selling expense is based on the estimated selling price. The cost per pound of cotton is determined by making an allowance for the waste as indicated on the cost cards.

Although cost figures seem to indicate that the new cloth should be manufactured, it is necessary to consider possible production difficulties which may make it inadvisable to add it to the mill's production. At best the mill can only estimate manufacturing difficulties. In the past the superintendent and overseers have manufactured new styles of cloth which have proved to be failures. Mill operatives are most efficient on standard cloths upon which they have worked for a long time. The looms, moreover, must be adjusted to the new cloth; this not only takes experimentation, but also may present difficulties that cannot be overcome. The waste resulting from bad weaving or from lack of skill on the part of operatives frequently may destroy all the paper profits shown by the cost accountant.

Trial tests often have misled executives, due to the fact that the sample weaver is generally above the average in skill and that extra attention is given to the style of cloth both by the weaver and superintendents. One executive invariably has followed the rule never to adopt a style until it has been tried out on a sufficient number of looms so that it would be manufactured under actual working conditions by weavers of average skill.

In this case the mill superintendent and the overseer in charge of the weave room decided that the cloth probably would weave without excessive waste with 18 looms to an operative. They estimated the cut price at 65.5 cents.

Besides production cost data the treasurer also must consider market conditions. The mill has been running at capacity for some time but profits have been small. Since it has produced only standard print cloths, sateens, and gauzes, it has been able to dispose of all its output although practically at cost. The market for the new cloth is exceptionally strong and will prob-

ably bring in three or four times the profit per pound of the style number 316. This market, however, is restricted to one trade, corset making, and the high profits soon may cause a glutting of the market. The treasurer, furthermore, has always opposed frequent changing of the styles of product because of the disruption of the organization and production facilities.

Should the Bolten Mills manufacture the new style of cloth?

12. JACQUES-ROSE PRODUCTION COMPANY—WRITING OFF PRODUCTION COSTS OF MOVING PICTURES

The Jacques-Rose Production Company charged off the total production costs of a picture at the time of its release. The rental account in the general ledger was debited with the production costs of all pictures and credited with their income. This method did not give a true picture of facts either on the balance sheet or in earnings. If a picture were released in November or December no value for it would be found on the balance sheet of December 31, although it was an asset.

Costs and rental records were kept by monthly periods for each picture. During the production of a picture, cost reports were sent in weekly on a Summary of Unfinished Pictures Cost Sheet. The costs of a picture varied from $100,000 to $500,000.

Sometimes a picture would prove unsuccessful and have to be recalled at the end of six months. Others were exhibited for three or four years. The average exhibition value of a picture was two years, but its income after the second year rarely netted a profit. The costs of distributing the pictures arose from the maintenance of 18 exchanges in various parts of the United States which were clearing houses for Jacques-Rose films. The rentals in small theaters where pictures were exhibited after the second year were generally $5 a day, which was insufficient to meet the exchange expense and transportation charges. It was believed a good policy, however, to retain this business for its advertising value.

A picture always started at the "first run" theaters in key cities and then moved out to the second and third class city theaters. The rate of rentals decreased as the picture moved to smaller theaters and towns. On the average 88% of the total income of a picture was realized during the first year after its

release. The proportions of the total income of pictures by months were as follows:

1	17%	7	4%	13	1%	19	1%
2	19	8	4	14	1	20	1
3	14	9	3	15	1	21	1
4	9	10	3	16	1	22	1
5	6	11	3	17	1	23	1
6	4	12	2	18	1	24	1

It was suggested that during the first year after a picture was released 1/12 of 88% of the total production cost should be charged off each month and the second year 1% of the total production costs should be written off each month. By making the amount uniform, clerical work would be reduced to a minimum.

Another plan was to write off production costs at the same ratio each month as the average income. Under such a plan 17% would be written off the first month, 19% the second, and so on, as indicated by the above table. This was said to be more accurate as the decline was in exhibition value and not physical depreciation. The positive prints sent to the theaters were made on celluloid from the original negative. These wore out in one year and were charged off immediately.

What plan of writing off production costs should the Jacques-Rose Production Company adopt?

13. METONOMEE MACHINE COMPANY—USE OF TABULATING MACHINES

Tabulating machines were discarded by the Metonomee Machine Company after two years' usage. The machines had been installed in order to facilitate cost and sales analyses of the company's 25,000 products. Although they had given excellent statistical results, they were not considered economical since they were idle three-quarters of the time.

The Metonomee Machine Company manufactured a wide range of machines and machine parts, from small screws and stamped goods with a unit value of 10 cents to large power machines with a value of $200,000. These were sold by the company directly to consumers. Many small orders of 25 parts

were received, for which the longest operation consisted in setting up the machines. Some orders were in process 10 minutes, others a year. In addition to six manufacturing departments, the company was departmentalized as follows:

Receiving	Drafting	Repair	Shipping
Stores	Experimental	Painting	Power
Engineering	Testing	Assembly	

Approximately 1,200 jobs were in process at all times. Costs were kept by order number, and the factory paper work averaged daily 1,500 time slips for the 500 employees and 2,000 requisitions for material.

The cost department consisted of seven factory clerks, seven timekeepers, eight stock-record clerks, two filing clerks, one payroll clerk, one cost clerk, and one estimator. A shop clerk and timekeeper were at each foreman's desk. The timekeeper kept the time slips for direct and indirect labor in each department. The shop clerk received from the production department the job orders which were to be started during the day. He then notified the storeroom to release the necessary material and deliver it to him. After the count was verified, the clerk assigned the jobs to the men. The requisition was sent to the cost department where a stock clerk made the proper entries on the balance-of-stores sheet. In addition to posting the requisition to the inventory record, the stock clerk priced the requisition and extended and calculated the value of the materials. Requisitions were sorted by job order and expense classification numbers and filed in that way in a vertical file.

The payroll clerk received the time slips from the factory timekeeper, rated the cards, extended the labor costs, and made the cost analyses. He also made up the payroll. The time slips were sorted by jobs and expense number and filed in the same vertical file as the material requisitions.

The senior cost clerk received notification from the departmental cost clerks when each job was completed and sent to finished stores. He then took all the papers on that job number from the file and tabulated a summary cost sheet for the job. Direct labor charges were secured from the time slips and the direct materials from the material requisitions. Overhead was applied to the job by the use of a system of standards based

on a percentage of direct material and labor. The cost clerk then made summary entries for the journal such as:

1. Finished Goods
   To Work in Process
   Burden Apportioned

2. Burden Apportioned
   To Expense

From this point the work of the cost clerk was statistical. Costs were compared with the standards set up for each job, and variations were discussed with the plant superintendent.

The estimating clerk calculated from specifications the cost of any new part or combination of parts. This estimate was based on the data contained in the cost files. The statistics which the company prepared from its cost records included the distribution of each payroll item into expense and costs. He also worked out job analyses by production orders and by operations. The tabulating machine had been installed to perform these operations. Before its installation the compilations had been made on separate sheets for each job by a stock clerk using a calculating machine; he sorted the original time and material slips by hand. With the tabulating machine the computations were made by jobs and by operations and footed daily. Postings were made from these footings to the cost sheets. It was found that although the machine did the work much more quickly, it was not working more than 25% of the time and had not released any of the employees of the cost department. The controller of the company was convinced that the tabulating machine should be discontinued because of its idle time. He had concluded, however, that if more than two classifications or analyses were to be made from any one set of basic records, it would be economical to have the tabulating machine. He believed that the staff of the cost department could be reduced by using the tabulator under such circumstances.

14. THE DRAKE SPECIALTY STORE—BUDGETING EXPENSES AND PLANNING SALES

In April, 1922, the president of the Drake Specialty Store directed the controller to prepare a report recommending a gen-

eral plan for controlling expenses through budgets. The controller's general recommendations were as follows:

An expense committee should be appointed consisting of the general manager, the merchandise manager, the store superintendent, the personnel manager, and the controller. The first duty of this committee should be to divide the store's total expense budget into controllable sections and in each case to make some one executive definitely responsible for keeping the expenditures in his section within the budget.[1] The committee should not attempt to hold an executive responsible for expenditures not definitely under his control. For instance, the head of a selling department should not be made responsible for general administrative expenses prorated to his department.

It is recommended that the starting point in preparing a budget be planned sales, and that the merchandise manager be requested to forward to the expense committee, 60 days before the beginning of each season, his sales estimates for the season by departments after they have been approved by the general manager. The committee, working from these planned sales figures, should develop expense budgets for each selling department and also for each non-selling department. Budgets for the selling departments and non-selling departments should then be combined to form the total store budget. In case the total planned expense for the season is then found to be larger than desired, the committee should go over the estimates for the selling and non-selling departments and cut them down wherever possible in order to achieve the figure desired.

After the budget has been approved, the individual budgets for the various selling and non-selling departments should be turned over to the respective managers of those departments as their "open-to-spend" limits, and throughout the year actual expenditures should be carefully compared with estimated expenditures. The head of each controllable section should be responsible for seeing that the departments within his section do not exceed estimates without valid reason.

In planning expenses it is recommended that the president of the store set up a goal from which the expense committee should work. It is further recommended that this goal be one difficult to attain. Our expense percentage last year was 29%. The goal for the fall season of 1922 might well be set at 25% or 26%. To reach that amount important reductions would have to be effected in many departments, and in order to make these reductions the committee would have to do a large amount of studying and analyzing. In fact, the policy of setting up a difficult goal might lead to careful job analyses,

[1] In addition to the buyers and their assistants who were in charge of the actual buying and selling operations in each department, the Drake Specialty Store had the following executives: president, treasurer, general manager, merchandise manager, controller, store superintendent, personnel director, advertising manager, credit manager, delivery superintendent, superintendent of receiving and marking, superintendent of alteration and manufacturing operations, and office manager.

the introduction of scientific methods, and material reductions in expense. It is not recommended that these innovations be adopted at once, but rather that the committee work into them gradually.

Since the controller recommended that planned sales should be used as a basis in developing expense budgets, the president directed the merchandise manager to investigate the possibilities of developing a more exact method of planning sales in the Drake Specialty Store.[1] Formerly it had been the practice in the Drake Specialty Store to plan sales for the store as a whole and for each department by months for a season in advance. These estimates were made roughly by the merchandise manager in conference with the department buyers, and usually they were ready for presentation to the general manager a month or six weeks before the opening of the new season. In his conferences with the buyers, the merchandise manager had attempted to arrive at sales estimates that would reflect the normal growth of the store, the purchasing power of the store's customers as compared with the corresponding season of the preceding year, general economic conditions, the share of the community's business that the Drake Specialty Store desired to get, style conditions in the merchandise in individual departments, and the rate of stock-turn

[1] Some controllers favor using planned expenses as a basis for planning sales rather than using planned sales as a basis for planning expenses. The following is an excerpt from an article written by the controller of a Chicago department store on this subject:

"The use of the expense basis necessitates a careful budgeting in advance of departmental expenses, both direct and indirect. In a going business with adequate records of past sales and expenses, it is possible to determine for a given period in advance approximately the amount of total expense in dollars and cents for each department. Suppose that for a given department for six months the estimated expense is $30,000, and the expected gross profit is 33⅓%. This means that a volume of sales of $90,000 would exactly cover the estimated expenses but would leave no net profit. On the assumption that the store desires this department to show a net profit of 10% on cost of merchandise sold, the procedure is as follows:

"Selling price, 100%, minus gross profit, 33⅓%, leaves cost of merchandise sold, 66⅔%. Since 10% profit on cost is desired, 1/10 of 66⅔%, or 6⅔%, is subtracted from the gross profit, 33⅓%, leaving a figure of 26⅔%. This figure is obviously the necessary expense percentage of the department if a net profit of 10% on cost is to be realized. The estimated expense of the department in dollars and cents, $30,000, divided by 26⅔%, the necessary expense percentage, gives a result in round numbers of $112,500. This sum is the volume of sales necessary to secure the desired results in this department. The proof is as follows:

"Thirty-three and one-third per cent of $112,500 equals $37,500, the gross profit. This amount, $37,500, minus $30,000 equals $7,500 net profit. Net sales, $112,500, minus $37,500 gross profit equals $75,000, cost of merchandise sold. Net profit $7,500, is 10% of $75,000, cost of merchandise sold.

and expense percentages in the Drake Store as compared with those in similar stores elsewhere. On the basis of these considerations the merchandise manager had increased or decreased his estimates from the sales actually made by each department in the corresponding season of the preceding year. No attempt, however, had been made to compute the amount of increase or decrease mathematically. Rather, the merchandise manager had considered the various factors affecting each department and had then decided that for the coming season its sales would be greater or less than in the preceding season by a certain percentage.

The Drake Specialty Store operated on the retail method of inventory and used the classification of accounts recommended by the Controllers' Congress of the National Retail Dry Goods Association; it belonged to an association of similar stores organized for the purpose of comparing operating figures. About 250 persons were employed, half of them being classed as non-selling employees. The store had net sales of slightly over $3,000,000 a year. Its 33 departments included women's suits, waists, coats, costumes, furs, skirts, millinery, neckwear, gloves, jewelry, and various complementary departments selling ready-to-wear articles for women, misses, children, and infants.

The petticoat department was fairly typical of most of this store's ready-to-wear departments. In this department, however, the collection of statistical information had been carried to greater lengths than in most of the other departments of the store. Its merchandise was divided into the following classifications: evening, jersey, satin, taffeta, jersey top, knickers, and extra size. The following statistics were available in this department for each season:

Gross sales in pieces and in dollars by merchandise classifications

Purchases in pieces, and in dollars cost and retail, by merchandise classifications

Stocks in pieces, and in dollars cost and retail, at the end of each month by merchandise classification

Mark-downs at retail in dollars

Returns and allowances at retail in dollars

Price range by merchandise classifications

Rate of stock-turn

Maintained gross margin in dollars
Direct expense in dollars under the following classifications:

Advertising	Bonuses
Buying salaries	Other department salaries
Traveling expenses of buyers	Selling salaries

Prorated expense in dollars under the following classifications:

Administrative and General	Buying
Occupancy	Selling
Publicity	Delivery

Should the store have used planned sales as a starting point in budgeting expenses? If not, what should have been the starting point?

Should the general method have been to work from sales to expenses and stocks, or from expenses and stocks to sales?

In budgeting expenses should the store have proceeded by setting up an arbitrary expense percentage to be reached if possible, or should it first have undertaken job analyses to determine reasonable minimums for the various items of expense?

What items of expense under each of the functional divisions (administrative and general, occupancy, publicity, buying, and selling) should have been regarded as controllable in the individual selling departments?

Into what sections should expenses have been divided for the purpose of control by the various executives? What item should have been included in each section?

How should the available data have been used in arriving at planned sales figures?

15. UNIFORM COST SYSTEMS—THEIR LEGAL STATUS

The question has from time to time been raised as to whether the use of uniform cost systems within associations of manufacturers engaged in the production of the same or similar articles is in conflict with the federal antitrust laws. It has, for instance, been suggested that the decision of the United States Supreme Court in the American Hardwood Case [1] would interfere with

[1] *American Column and Lumber Company et al* vs. *United States of America*, 257 U. S. 377.

some of the practices of those associations which have developed cost accounting systems for the use of their members. A perusal of the decision will show that there is no reference to cost accounting in it, but that the practices which were there condemned related to the exchange of information as to sales, prices, and market conditions among the members, the furnishing of such information being practically compulsory upon members, and so complete that, in the opinion of the court, it constituted the entire group of members into a single unit as regards its position in the market.

Nevertheless, the question still exists as to the propriety of certain methods and practices of manufacturing associations which have adopted uniform cost systems.[1] A letter addressed to the Federal Trade Commission by the United States Chamber of Commerce on July 19, 1921, says in part:

> We refer to a standard plan or methods which may be developed and used by the producers of a certain line whereby they figure their costs by the same rules, including in them the same elements, and differing only in results because of the variance in size of plants, equipment and local conditions—uniform as to fundamentals.
>
> Is there, in your opinion, any reason why such a system may not be developed and used lawfully by an industry? Again, if conversion costs only be dealt with, is there any legal bar to the collective study of costs by the members of an industry using such a Uniform Cost System?

In the reply of the Federal Trade Commission the following passage appeared:

> As long as the principles of cost accounting are sound and the methods used are adopted to secure accuracy of individual results, and provided that the results are not used directly or indirectly for ulterior purposes of an illegal character, the Federal Trade Commission is in favor of the study and development of uniform cost accounting by trade associations, or otherwise.
>
> There is evidently nothing illegal in such a practice, but it is always well to remember that, though innocent in itself, it has sometimes been perverted to serve the ends of collusive price control, and, when it is so used, no matter whether directly or indirectly, then restraint of trade is involved.

Further inquiry brought the following restatement of the attitude of the Federal Trade Commission:

[1] In Bulletin No. 11 of the Production Department of the Chamber of Commerce of the United States.

Stated in another way, the conception of the Commission is that the efforts of a trade association to educate the individual member in the application of sound principles of cost accounting in his individual business, are proper. But that any subsequent effort of the association to reduce the individual costs to an average or uniform cost basis and to procure the use of the group standard as a basis of price making by each of the individuals in the group, is improper. The individual must fix his own cost and his own margin. The group may not attempt to substitute a group average or standard either of cost or margin for the individual's figures without being in peril of becoming an unlawful combination.

Applying this statement to your interpretation of our letter of the 25th, it may be said that for a trade association to set up and induce the use by its members of a scientific and accurate plan of cost accounting is not only legal but highly beneficial to the individual members of the association. The use of this legal and highly beneficial information by each individual in establishing his own production cost and determining his own margin, is entirely proper. If thereafter the association attempts to induce its members to disregard their own varying figures and use a common average or uniform figure of cost or margin or both, it has departed from its proper position of instructor and may easily take on the appearance of a price-fixing combination in restraint of trade or in suppression of competition.

How far the association can lawfully go in acting as the medium of exchange of cost data among its members can only be determined after the decision by the United States Supreme Court in the pending action against the American Column and Lumber Company *et al*, in which this question is involved.

As to the last paragraph, it will have been seen from the statement relating to the American Column and Lumber Company that the question of the exchange of cost data was neither brought up nor settled in this case, but only the question of the exchange of sales data. It is, however, of interest to observe, from the following quotation from the decision, what the precise element was which the Supreme Court decided to be open to condemnation:

It is plain that the only element lacking in this scheme to make it a familiar type of the competition suppressing organization is a definite agreement as to production and prices. But this is supplied: by the disposition of men "to follow their most intelligent competitors," especially when powerful; by the inherent disposition to make all the money possible, joined with the steady cultivation of the value of "harmony" of action: and by the system of reports, which makes the discovery of price reductions inevitable and immediate. The

sanctions of the plan obviously are, financial interest, intimate personal contact, and business honor, all operating, under the restraint of exposure of what would be deemed bad faith and of trade punishment by powerful rivals.

A publication entitled *"The Glass Industry,"* by the Bureau of Foreign and Domestic Commerce [1] quotes with apparent approval the substance of an article by Mr. Herbert B. Garwood in the following terms:

He suggests that manufacturers, acting together, should publish the results of a study of their predetermined costs for the benefit of themselves as well as of their uninformed competitors. He says that this accurate knowledge of the lowest costs which have been obtained would result in the elimination of preventable waste and in a decrease of price cutting. Such data, if accessible to all manufacturers, would, in his opinion, cause them to fix selling prices with much greater uniformity than has been customary.

In a letter to the Attorney General,[2] Mr. Hoover discusses the matter at length, and asks the following question:

(1) May a trade association provide for its members a standard or uniform system of cost accounting and recommend its use, provided that the costs so arrived at by the uniform methods are not furnished by the members to each other or by the members to the association, and by the latter to the individual members?

The Attorney General replied, in part:

With reference to the first paragraph, there is no apparent objection to a standard system of cost accounting, but I think associations should be warned to guard against uniform cost as to any item of expense—It is as clearly a violation of the law to agree upon the cost of an item that constitutes a substantial part of the total cost price when its cost actually varies, as to agree upon the sales price, because the sales price is substantially affected by such agreement.

The A. B. Association has appointed a committee to make recommendations looking to the adoption of a cost accounting policy and program. Draw up a set of recommendations for the committee to submit, which would enable the association to render the best possible service to its membership, and yet would conform to the legal requirements laid down.

Define precisely, on the basis of public policy, what proceed-

[1] Miscellaneous Series No. 60, page 327.

[2] Dated February 3, 1922: Commerce Reports, Feb. 20, 1922, page 415.

ings in the cost accounting activities of an association should, in your opinion, be permitted, and what should be regarded as objectionable? [1]

[1] See article, *Harvard Business Review*, January 1923, pp. 167-174.

REFERENCES

BERNDT, IRVING A. *Costs—Their Compilation and Use in Management*. H. P. Gould Co., 1920.

BLISS, J. N. "Cost Methods in the Packing Industry," *N. A. C. A. Official Publications*, Vol. III, No. 14.

CHURCH, A. H. *Manufacturing Costs and Accounts*, pp. 93-95.

COLE, WILLIAM MORSE. *Accounts—Their Construction and Interpretation*, pp. 111-112.

DUNKERLEY, ROLAND, et alii. "Executive Uses of a Cost System," *N. A. C. A. 1921 Year Book*, pp. 249-281.

FERGUSON, WILLIAM B., and LYBRAND, WILLIAM M. "Relationship of Cost Accounting to Business Management," *N. A. C. A. 1920 Year Book*, pp. 65-92.

JORDAN, JOHN P., and HARRIS, GOULD L. *Cost Accounting*, pp. 344-345.

JORDAN, HAROLD C. "Accounts for Manufacture of Wood Veneer," *Journal of Accountancy*, Aug., 1920, pp. 118-124.

MCKINSEY, J. O. *Budgetary Control*. Ronald Press Company, 1922.

VAN DEVENTER, J. H. "Organization and Operation of the Cost Control Committee Plan," *Industrial Management*, May, 1922, pp. 267-271.

WELLINGTON, C. O. "How Cost Systems Help Superintendents," *Paper Maker*, July 1, 1922, pp. 10-13.

WHITESTONE, S. L. "Cost as a Basis of Management," *N. A. C. A. 1922 Year Book*, pp. 277-283.

WOODS, C. E. "Plant Order and Register Division of Inventory Control," *Administration*, Sept., 1921, pp. 330-344.

——— "By-Products and Costs," *Accountant*, Sept. 29, 1917, pp. 233-236.

——— "Cost Accounting for By-Products," *N. A. C. A. Bulletin No. 10*, Aug. 15, 1921, pp. 38-39.

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